SURGICAL OPERATIONS

PFEIFFER—WILLIAMS

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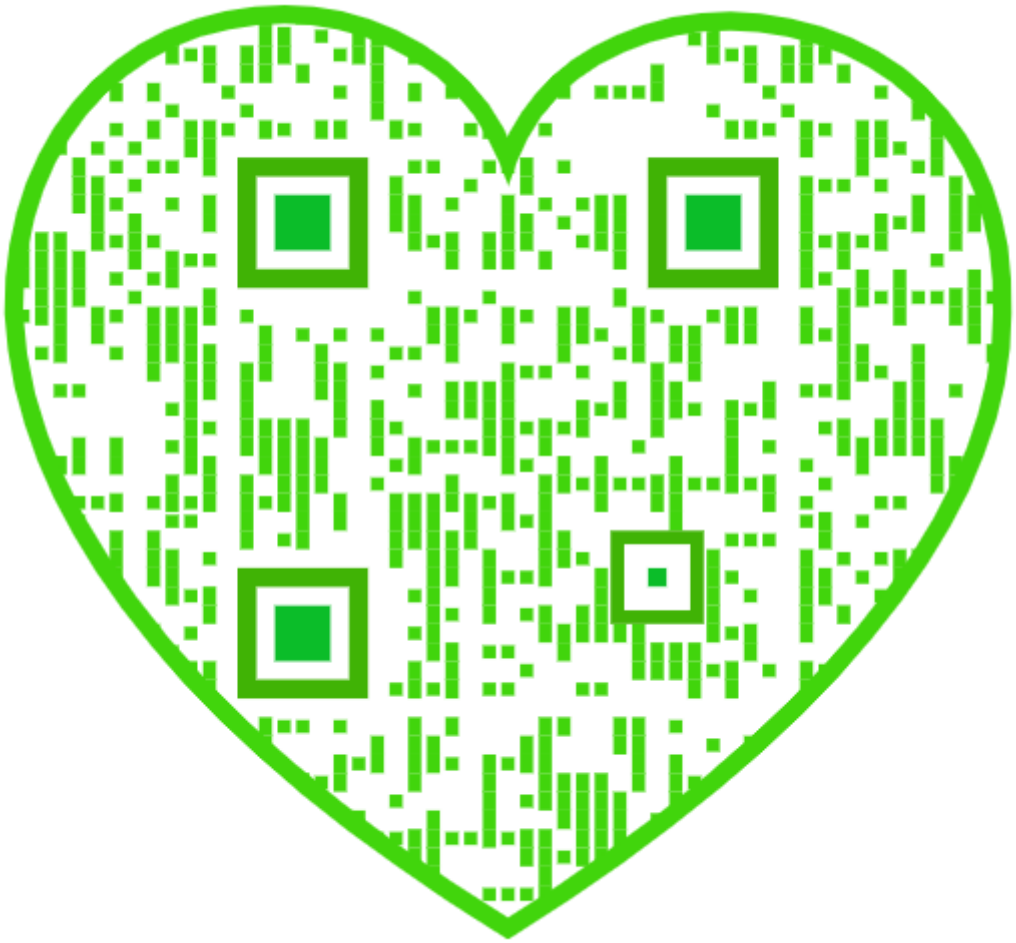

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UNITED STATES OF AMERICA.

A COURSE IN

SURGICAL OPERATIONS

FOR

Veterinary Students and Practitioners

BY

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AND

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With an Introduction by PROF. DR. FRÖHNER.

With 42 Original Illustrations.

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INTRODUCTION TO DR. PFEIFFER'S OPERATIONS-CURSUS.

The publication of a brief introduction to operations has become a pressing need in the operative exercises which have been conducted jointly by the author and the undersigned, during the winter semester in the (Berlin) Veterinary High School.

The submitted guide is intended primarily to serve as a catechism to the student in the technique of operations and to support the oral explanations in the course by text and illustration. Consequently only the most difficult and complicated, to an extent the instrumental operations, are described as briefly as possible and fundamentally from the standpoint of technique. Designedly also only one method of operation is described, as a rule, namely, that one which from the standpoint of personal clinical experience has proven the best, as for instance, castration by the method of torsion, the Bayer operation for quitter, our method of resection of the tendon of the flexer of the os pedis, etc.

The multiplication of methods confuses the beginner readily; as an important lesson in operative instruction, the student must become thoroughly acquainted, among other things, with *one* method with which he becomes so familiar that he can rely upon it with perfect trust in practice From this standpoint also the needs of the veterinary practitioner are met, who find in the same, besides the most important operations on the horse, also some in cattle (amputation of the claws) and dogs (entropium operation).

In order to confine the handbook within proper limits, the minor operations (sutures, cautery, catheterization, etc.), the

instruction regarding instruments and bandaging, as well as the methods of restraint, have not been considered. In the same way the indications for performing the described operations are relegated to the lecture and the text books of operative surgery.

Finally, we beg to acknowledge the estimable manner in which the illustrations have been made from the original by Mr. Max Fischer, student, Berlin.

PROF. DR. FRÖHNER.

Berlin, September, 1897.

PREFACE TO ENGLISH EDITION.

Professor Fröhner's foregoing introduction to Dr. Pfeiffer's manual explains fully its object. Having found it essential to effective instruction in surgical technique, that the student should have extensive laboratory experience in the more intricate surgical operations (the proper performance of which perforce, includes training in methods of confinement, anaesthesia, antisepsis, hemostasis, suturing, bandaging, etc.,) we have conducted a course in operations upon anaesthetized animals, which are destroyed while yet unconscious, by which the student becomes familiar with the various operations under the normal conditions in the living animal.

The non-existence of a satisfactory manual in English induced us to ask Dr. Pfeiffer's permission to translate and use, so far as might suit our purposes, his Operations–Cursus, to which he readily assented, and in which his publisher, Mr. Richard Schoetz, concurred. It is, therefore, largely due to their courtesy and liberality that we are enabled to present to English speaking veterinary students and practitioners this little manual, accompanied by the worth given it by the valuable experience of Prof. Dr. Fröhner and Dr. Pfeiffer.

With a view to enhancing the value of the work to British and American students, we have added some of the more recent, largely distinctively American, operations which we deem of sufficient value to warrant insertion in such a work. To this end, we have added cunean tenotomy, digital neurectomy, Bossi's neurectomy of the peroneal nerve, McKillip's operation for exploring the pharynx, Eustachian tubes, etc.

(staphylotomy.) Merillat's operation for "roaring" (arytenoidrraphy) and our own operations of trifacial neurectomy (for involuntary shaking of the head), repulsion of molars, irrigation of the trachea, caudal myotomy (for curved tail), caudal myectomy (for gripping of the reins), and vaginal ovariectomy.

In order to keep the volume of the work within bounds, we have omitted, not without regret, Dr. Pfeiffer's extirpation of the submaxillary lymph glands, subcutaneous caudal myotomy (nicking), and castration by torsion. The chapters and illustrations on trephining have been greatly modified, and we have occasionally introduced suggestions in [ ]. Most of the illustrations were supplied by Mr. Richard Schoetz, Berlin, from Dr. Pfeiffer's Operations–Cursus, the instrument figures were provided by John Reynders & Co., the remainder are from original drawings by Dr. E. Merillat, and Mr. C. F. Flocken, veterinary student: the chapter on Staphylotomy was contributed by Dr. M. H. McKillip, and that on Arytenoidrraphy by Dr. L. A. Merillat, to each of whom our indebtedness is heartily acknowledged.

W. L. WILLIAMS.

Cornell University, 1900.

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OPERATIONS ON THE HEAD.

EXTRACTION OF TEETH.

Fig. 1 and 2.

Instruments. Extracting forceps acting as a lever of the second class for the molars, extracting forceps acting as a lever of the first class for the pre-molars (the forceps for the superior pre-molars are bent), fulcra of various sizes, mouth opener with abundant lateral working room, reflecting lamp, exporteur forceps, toothpick, splinter forceps.

Technique. With quiet horses extraction may be carried out with the animal standing, the horse being backed into a corner. Resistant animals must be laid down. After the application of the mouth speculum the diseased teeth must be properly identified by manual exploration, it must be determined whether they are already loose or if they have an abnormal direction (for example, are misdirected toward the cheek), the condition of the neighboring teeth, etc. These investigations can be rendered easier in case of insufficient daylight by illuminating the mouth cavity with the reflecting lamp [or still better, by means of an incandescent electric lamp]. After the partially chewed food pellets have been removed with the toothpick or the fingers, count the teeth from before backward until the diseased tooth is reached, by passing the fingers along their median or inner sides. For the extraction of the molars, extracting forceps acting on the principle of a lever of the second class with fulcra are used, the latter having a plane and a convex surface.

The pre molar forceps are on the principle of a lever of the first class, those for the superior pre-molars are bent on the flat, because if they were straight the forceps handles would strike against the superior incisors and hinder the deep fixation of the forceps.

The next point is, to fasten only the diseased tooth with the forceps and to so apply them that the jaws of the same reach at least to the gums. For this purpose draw the tongue out from the angle of the mouth as far as possible on the sound side, introduce the hand into the mouth, and place the index finger on the posterior border of the diseased tooth, while with the other hand push the open forceps backward upon the tooth row until they reach the finger and grasp the crown of the affected tooth with the forceps jaws. The free

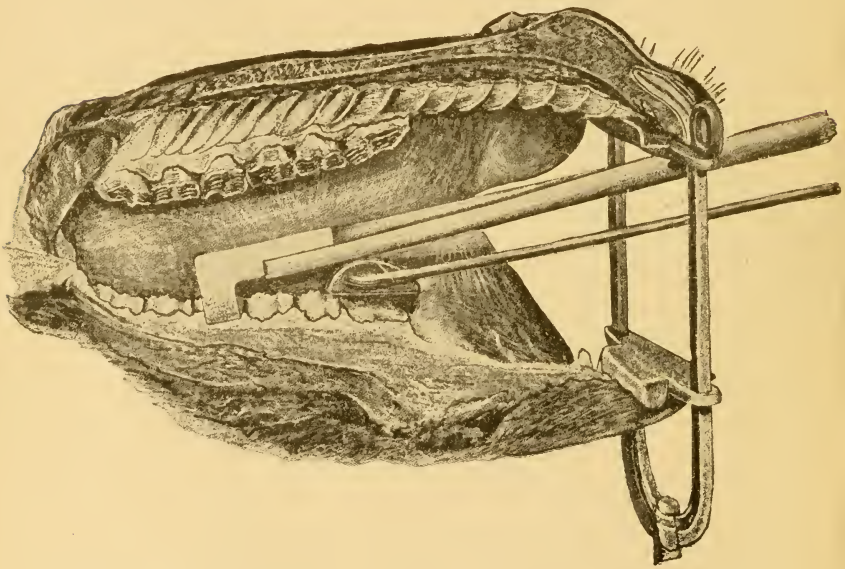

FIG. 1.—Extraction of the first inferior molar, viewed from within; sagittal section through the walls of the oral cavity.

hand is now withdrawn from the mouth, the forceps handles are grasped with both hands, and the tooth fang loosened in its alveolus by maintaining a gentle lateral movement, until the tooth evidently yields. The fulcrum is then carried in with one hand while with the other the forceps are maintained in the original position, and placed as far in as possi-

ble in such a manner that the plane side rests upon the grinding surface of the teeth. The fulcrum must be held firmly between the teeth and forceps in order that it shall not glide forward. The operator now lifts the tooth fang out of the alveolus in such a way that in the inferior molars the forceps handles are pressed downwards, the superior molars upward. In this way, while the tooth fang gradually comes out the forceps glide over the convexity of the fulcrum and favors the possibility of the tooth drawing out in the

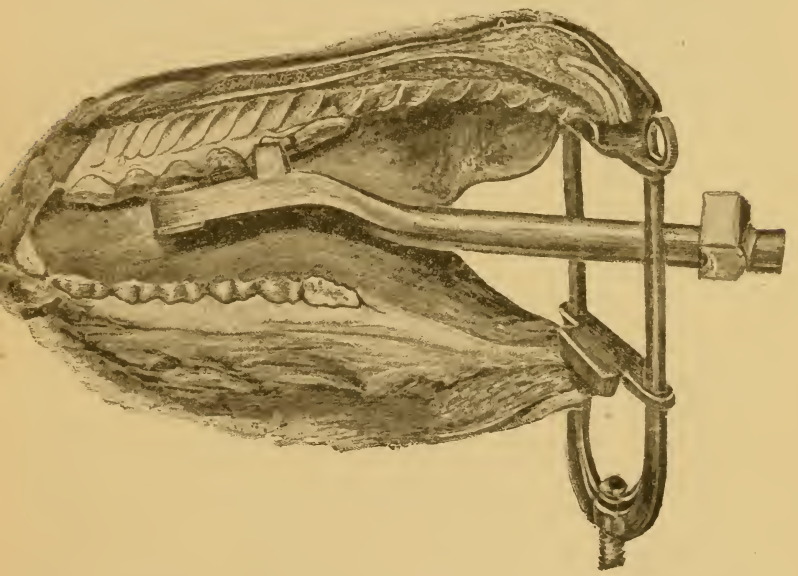

FIG. 2.—Extraction of the second superior premolar, viewed from within ; sagittal section through the walls of the oral cavity.

direction of its fixation. In case of the last molars as a rule the forceps push against the opposite row of teeth of the same side before the tooth is completely withdrawn. In this case the tooth, which is now loose in the alveolus, is either grasped more deeply by the forceps or is removed when this is no longer possible with the exporter or with the

hand. [In some young horses we have found it necessary to cut the tooth in two in its middle with tooth cutting forceps in order to remove it]. With the pre-molar forceps the fulcrum is placed beneath the extension in front of the jaws of the forceps.

This extension rests upon the grinding surface behind the diseased tooth and acts in such a manner that the pre-molars can be withdrawn from before backward in their line of direction. For the extraction of the inferior pre-molars the forceps handles must be pressed upward, in the superior downward. Satisfactory extraction can only occur after the disappearance of resistance is recognized, accompanied by a crepitant sound due to the entrance of air into the aveolus.

REPULSION OF TEETH.

[For the removal of molars and premolars and alveolar odontomes which cannot be extracted with forceps.]

Fig 3.

Instruments. Razor, convex scalpels (2), trephine, bone gouge, bone gouging forceps, light bone chisel, heavy bone chisel, mallet, compression forceps, curette, heavy tooth punch concave at distal end, scissors, needles, thread, absorbent cotton, antiseptic gauze, extracting forceps, heavy splinter forceps, dressing forceps, trachea tube, tenacula, metal probe, mouth speculum.

Technique. Secure in lateral recumbent position, produce anaesthesia, and if sinuses are involved in a way to make possible the inhalation of purulent matter, blood or other liquid, prepare for tracheotomy (which see) and perform it in time to avert any danger. Shave the region over the affected tooth and trephine by the method described in the following chapter down upon the fang of the tooth, or in case of odontomes, upon the tumor. In case of tooth fistula, the identity of the affected member is best ascertained by pass-

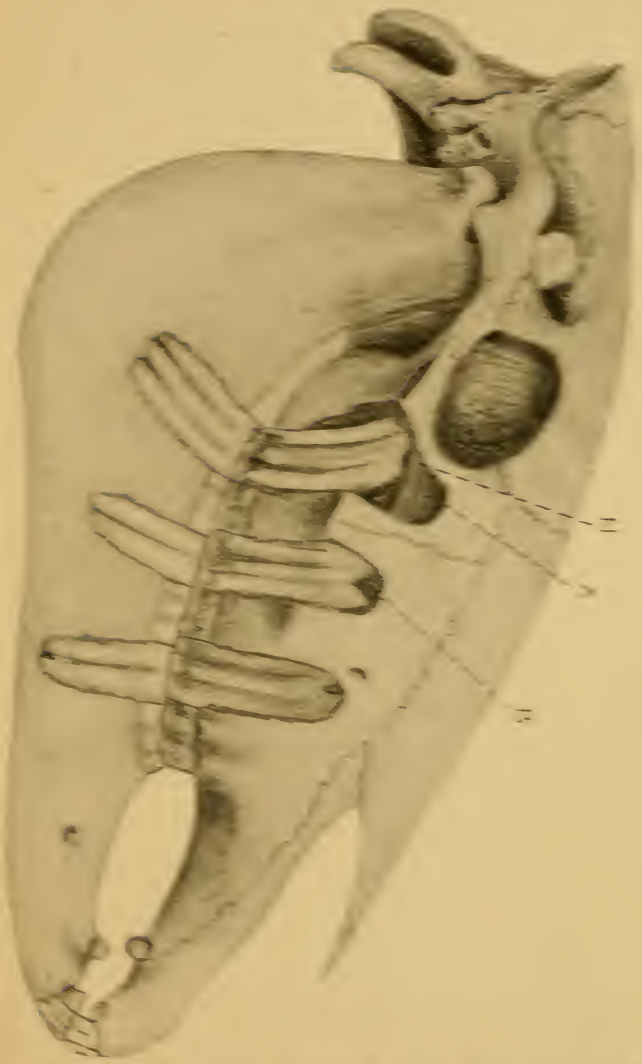

FIG. 3.—Repulsion of molars. Head of horse 4 years old, with mid premolars and first and third molars laid bare. *N*, Nerve canalet; *A*, superior maxillary sinus; *B*, inferior maxillary sinus.

ing a metallic probe through the fistula against the diseased fang while one hand is inserted in the mouth and determines the location of the probe. In trephining be careful to avoid injuring adjoining teeth. Control homorrhage completely after removal of the osseous disc and then enlarge the opening with forceps, gouge or chisel, until the entire width of the tooth fang is laid bare. Insert a sharp scalpel at the oral side of the trephine opening between the periosteum and superposed soft tissues and with the left hand in the mouth to act as a guide, push the scalpel along the periosteum until it enters the mouth and extend this incision backward and forward until the soft tissues are completely detached from the alveolar wall over the entire area of the affected tooth. With a light, narrow bone chisel, cut away the entire external bony plate of the alveolus, the full width of the tooth from the lower or oral margin of the trephine wound into the oral cavity. The chisel is to be so held that the outer edge is inclined from the tooth, otherwise the impact of the chisel may loosen the alveolar wall from the adjoining tooth. Drive the chisel for a short distance alternately on each side and thus avoid the splitting off of large sections of bone which might extend to the neighboring alveoli. With the gouge and chisel remove all remnants of bone covering the external or lateral side of the tooth. The soft tissues over the region are left undisturbed except the disc removed for trephining. When the tooth is bared the punch may be placed against the end of the fang and the tooth driven by a few firm, quick blows into the mouth where it is grasped by forceps or the hand and withdrawn. If this be impracticable or unsafe, comminute the tooth or tumor to the desired degree with the heavy chisel and hammer, and remove the pieces with gouge or forceps. Be careful to remove all fragments. Cleanse and disinfect the alveolus and tamponade with iodoform gauze or cotton, and dress daily. In chronic fistula of an alveolus after removal of a tooth by other means, remove the external bony plate in the manner described, as if for removal of the tooth.

TREPHINING THE FRONTAL SINUSES.

Fig. 4.

Instruments Razor, scissors, convex scalpels, compression forceps, tenacula, probe, trephine, bone scraper, curette, gouge, bone gouging forceps, hammer, chisel, disinfection material, absorbent cotton, long curved uterine dressing forceps, bone screw, lens shaped bone knife, probe pointed scalpel.

Technique. Shave or clip the hair from the region of the frontal bone at a level with the superior border of the orbital cavity and disinfect the area carefully. With a heavy convex scalpel make a circular incision, as large as the diameter of the trephine, the median border of which shall be 1 cm. from the median line of the face, directly through the skin, subcutem and periosteum, seize the isolated area with a tenaculum and with the scalpel or bone scraper detach the periosteum from the bone and remove in one piece, the skin, subcutaneous tissue and periosteum. Control hemorrhage. With the centerbit extended place the trephine accurately upon the denuded area, perpendicular to the surface of the bone, and by revolving it to and fro force the centerbit into the bone and continue until the trephine has cut well into the bone, when the centerbit should be withdrawn and the operation continued, being careful to maintain the trephine perpendicular to the bone. The operation is facilitated by grasping the trephine between the thumb and fingers of the left hand, constituting a conduit in which it can glide back and forth. The pressure under which the sawing is carried out must not be too great. When the bony plate which has been sawed around begins to loosen, the bone screw is screwed into the centerbit opening and the piece of bone is broken out, or it is pried out with the bone gouge or chisel. Uneven edges of bone should be smoothed with the lens-shaped knife. The abnormal contents of the frontal sinus can now escape or be re-

moved with curette, forceps and scissors, and the cavity irrigated with an antiseptic fluid. The frontal sinuses are in

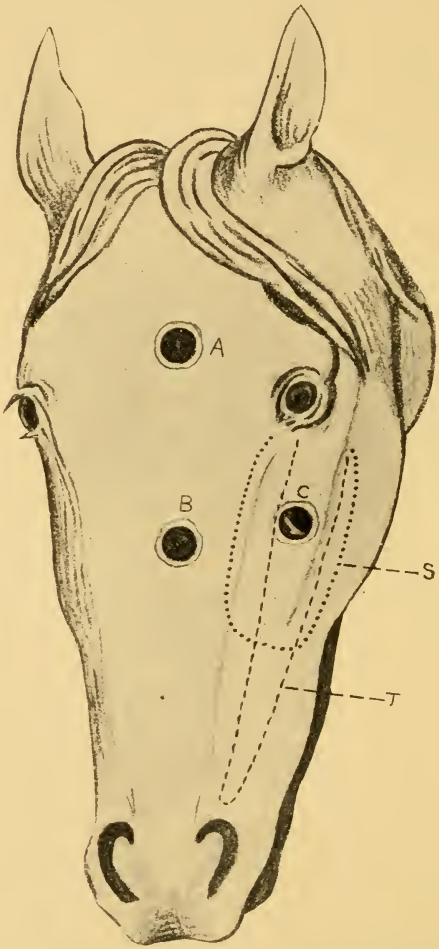

FIG. 4.—Trephining facial sinuses. *A*, Trephining frontal sinus; *B*, trephining nasal fossa; *C*, trephining maxillary sinuses; *S*, diagrammatic outline of maxillary sinuses; *T*, diagrammatic outline of inner face of the maxillary turbinated bone.

munication with the superior maxillary sinuses and the superior turbinated bone of the same side so that indirectly the irrigating fluid can escape through the nasal opening by way of the maxillary sinus or the injured superior turbinated bone. In order to prevent aspiration of the fluid, which is generally purulent, and to facilitate its escape, irrigation must be carried out with the head elevated and flexed. An artificial connection between the frontal sinus and the nasal passage can be made by passing the probe in a downward and inward direction, forcing it through the thin bony plates and mucous membrane of the turbinated bone and then by means of the probe pointed scalpel cut an opening about 2 cm. in diameter. In order to prevent aspiration into the lungs, the animal must be allowed to get up immediately, or if under anaesthesia, a tampon trachea tube should be inserted in the trachea. In case of severe hemorrhage, the cavity can be tamponed for twenty-four hours with a long strip of gauze one end of which hangs out of the wound and the tampon fixed in position by two sutures passed through the lips of the wound. The operation can be carried out in the standing position if the animal is quiet.

TREPHINING THE MAXILLARY SINUSES.

Fig. 4.

Technique. Shave the skin over the superior maxillary bone on the median side of the zygomatic ridge. Make a circular incision as large as the diameter of the trephine through the skin, subcutem and periosteum down to the bone, the lateral or outer margin of the circle being about 15 mm. nasalwards from the zygomatic ridge toward the lateral border of the levator labii superiorus muscle and place the trephine 7 cm. above the lower end of the zygomatic ridge. The trephining is carried out as described above. It must be remembered that the superior maxillary

bone increases in thickness toward the zygoma, so that the instrument must be held at an acute angle to the vertical plane of the zygoma. At the point directed the trephine opening lies partly on either side of the partition between the maxillary sinuses so that both cavities are simultaneously opened. This partition between the two sinuses varies in location with the age of the animal and in disease is frequently partially or wholly destroyed, so that in practice the division is frequently ignored. Should the partition not break out with the trephined disc of bone it must be cut away with the hammer and chisel or with bone gouging forceps. The inferior smaller maxillary sinus communicates through an elongated slit with the inferior turbinated bone, the superior larger maxillary sinus communicates directly with the nasal passage by means of the special naso-sinusal opening, so that the irrigation fluid can here also escape through the nasal passage. Care must be exercised to not injure the superior maxillary division of the tri-facial nerve in its course through the maxiliary sinuses, enclosed in its bony sheath. This bony conduit is, in rare cases, obliterated by pressure (odontomes) leaving the nerve stretched across the cavity as a white, nacrous cord, intensely sensitive. This neural conduit divides the maxillary sinuses into inner or median and outer or lateral compartments in such a way that trephining alone affords incomplete and unsatisfactory drainage. If a tooth has been repulsed ample drainage may be afforded into the mouth. Otherwise locate by digital exploration the lower border of the median or inner compartment of the sinus and make a second trephine opening over that point, insert the index finger of one hand through the trephine opening and rest it against the inner or median wall of the sinus formed by the maxillary turbinated bone, while with the other hand introduce the long curved uterine dressing forceps through the nostril up the nassal passage until the end of the forceps is felt with the finger, break or cut through the intervening wall and push

the end of the forceps into the sinus. Introduce a tapering, antiseptic piece of cheese cloth through the trephine wound, grasp it with the dressing forceps and draw it out until the lower end appears at the nostril while the upper end hangs from the trephine wound. The strip of cheese cloth may also be inserted by means of a probe, after the opening has been made. Arm a long probe with a strong thread, insert the probe through the trephine opening and the wound in the turbinated bone and pass it out through the nostril, attach the cheese cloth to the end of the thread and draw it into the wound by pulling upon the probe. Control hemorrhage during operation: a. From skin, by compression or ligation. b. From intre-osseous vessels, by plugging with a conical piece of wood pushed into the vascular opening or by absorbent cotton pushed into the channel with the point of a needle or tenaculum. c. From the sinuses or wounded turbines by packing with cheese cloth or cotton.

Remove tampons after 24 hours and renew for a second day if required. Leave all wounds open and irrigate with tepid antiseptics.

TREPHINING THE NASAL PASSAGE.

Fig. 4.

Technique. The trephining is carried out by the method described, in the region of the nasal bone, close by the median line of the face and according to indications either above or below a perpendicular line drawn from the lower end of the zygoma to the nasal arch. The operation must be immediately against the median line since otherwise the maxillary sinuses are easily opened or the superior turbine wounded at the point of insertion. Special care is also necessary in removing the disc of bone, because the superior turbine lies directly beneath it and bleeds profusely when wounded on its dorsal aspect. In all cases after trephining about the nose or face where inhalation of blood, septic

matter, or irrigating fluid, is liable to occur, perform tracheotomy before beginning the basic operation and retain the trachea tube until all danger is past.

LIGATION OF THE PAROTID DUCT.

Figs. 5 and 6.

Instruments. Razor, convex scalpel, straight probe pointed scalpel, tenaculum and ligation forceps, tenacula, needle holder, needles, thread, probe, absorbent cotton, curette.

Technique. In case of salivary fistula, divide the fistulous

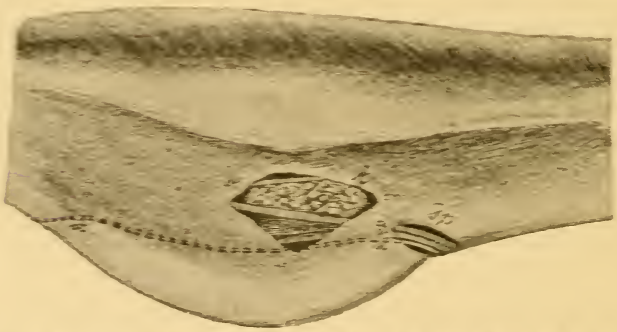

FIG. 5.—Intermaxillary space of the head of the horse lying on the side, seen from beneath. *sp*, Ligation of the parotid duct; *a* external maxillary artery; *v*, external maxillary vein; *st*, parotid duct.

opening in the skin and subjacent tissues toward the parotid gland with a probe pointed scalpel and lay the parotid duct free for a distance of from 1 to 2 cm. on the proximal side of the fistula. If the fistula has its location on the side of the cheek, cast the horse and shave and disinfect the vascular region of the inferior maxilla. When the operator glides a finger over the vascular region from before backward there is felt a resistant cord, the external

maxillary artery about 3 mm. in diameter, pulsating in the living animal.

Between this and the oral border of the masseter muscle make an incision about 4 cm. long parallel with the artery through the skin and skin muscle. This incision is more readily made by gathering up a fold of skin about 1 cm. high and cutting through this fold. Raise the loose connective tissue with a pair of forceps and excise it. Immedi-

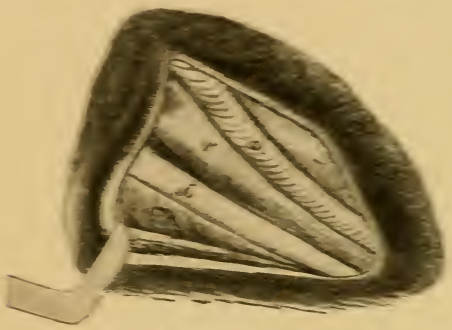

FIG. 6.—Ligation of parotid duct. (Life size.) *a*, external maxillary artery; *v*, external maxillary vein; *d*, parotid duct; *m*, masseter muscle.

ately behind the external maxillary artery is the external maxillary vein and behind this and immediately on the oral border of the masseter muscle lies the parotid duct. In case of salivary calculi which cannot be removed through the mouth, and cystic dilation of the parotid duct, make the cutaneous incision at the affected point, open the parotid duct, and after removal of calculus, etc., close the wound by means of intestinal sutures in such a way that the external surfaces of the lips of the wound in the wall of the duct are brought in contact, or ligate the duct on the proximal side of the point of operation. Ligation is accomplished by passing a strong silk thread behind the diseased part by means of a curved needle, carrying it around the parotid

duct and tying with a surgeon's knot. The parotid duct can also be previously split and an internal wound made at the point of ligation. Close the skin wound by means of a continuous suture like an overcasted seam and cover the operative surface with iodoform collodion.

ENTROPIUM OPERATION.

Fig. 7.

Instruments. Razor, scissors, mouse-tooth forceps and ligation forceps, needles, thread, 3 per cent. borax solution.

Technique. Confine the animal in the lateral recumbent position [or in the horse operate standing] shave the skin of the affected eyelid and disinfect. Grasp the skin of the eyelid midway between the inner and outer canthus either

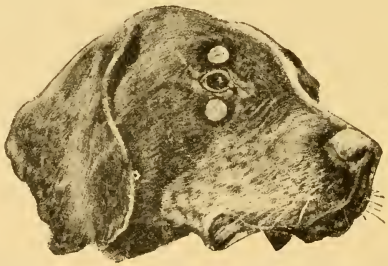

FIG. 7.—Entropium operation on the superior and inferior eyelids of the dog.

with fingers or mouse-tooth forceps and elevate a fold of the skin parallel with the border of the eyelid to such a height that the inverted eyelid assumes its normal position. Pass one finger into the conjunctival sac to make sure that the conjunctiva is not drawn into the skin fold. The fold is then clipped off with the scissors immediately below the forceps. Between the border of the lid and the border of the wound the skin must be left intact for at least .5 cm. Bleeding vessels are ligated and the wound closed by means

of interrupted sutures. In the dog a funnel shaped hood can be applied after the operation, in horses a flap can be applied made from several thicknesses of soft gauze [or generally left uncovered with safety.]

STAPHYLOTOMY.

[McKillip's operation for making a manual exploration of the Eustachian tubes, guttural pouches, pharynx and posterior nares, and for operations upon those structures.]

Instruments. (*a*) A ratchet mouth speculum. (*b*) A short, curved, probe pointed bistoury equipped with a ferrule to fit the middle finger.

Restraint. The patient is cast and secured in the lateral (costal) recumbent position and the head is turned upward.

Technique. The mouth speculum is adjusted and opened as far as is possible; the tongue is protracted with the left hand while the right containing the knife on the middle finger is passed carefully through the fauces until the knife hooks over the posterior border of the soft palate. The knife is then gently drawn forward so as to make an incision along the median line of the soft palate from the posterior border to its attachment on the palatine bone. The hand is then retracted and the speculum removed for a few minutes to permit the patient to rid its throat of the slight hemorrhage and mucus that might have accumulated.

Readjusting the speculum as before the right hand is again passed through the fauces and now that the palate is divided a digital exploration will perfectly reveal the presence of any abnormality in the region.

TRIFACIAL NEURECTOMY.

(For relief of involuntary shaking of the head.)

Fig. 8.

Instruments. Razor, scissors, convex scalpel, tenacula, aneurism needle, compression artery forceps, needles, thread, absorbent cotton, a stout piece of muslin 12 cm. square.

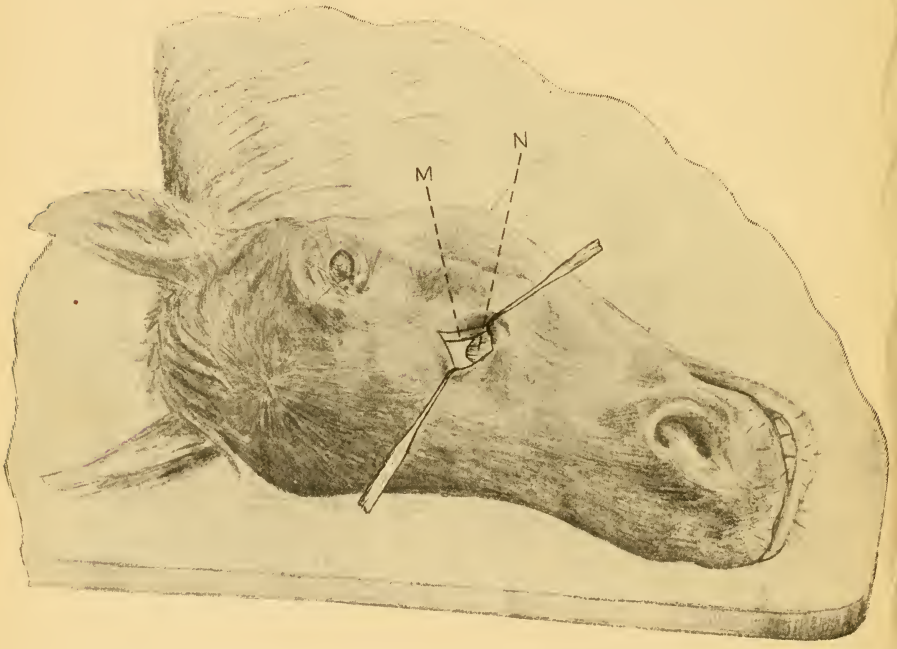

Fig. 8.—Trifacial neurectomy. *M*, Depressed levator muscle of the upper lip; *N*, supermaxillary division of the trifacial nerve at the infra-orbital foramen.

Technique. Secure in lateral recumbency and produce anaesthesia. Remove the halter, bridle or other head-gear. Shave and disinfect an area 8 to 10 cm. square over

the infra-orbital neural foramen. Locate by touch the infra-orbital foramen below the levator labii superioris proprius muscle and displace the latter downwards (toward the inferior maxilla) until the foramen can be felt above the muscle. With the muscle displaced begin an incision, above the levator muscle in order to avoid the branches of the glosso-facial vessels below it, 1 cm. above the foramen and carry it downward directly over the middle of the 5th nerve a distance of 5 or 6 cm., cutting through skin, subcutem and the levator labii superioris alaque nasi muscle, laying bare the nerve at its emergence from the foramen. Let an assistant hold the lips of the wound apart and the levator muscle downwards with two tenacula, dissect away the connective tissue surrounding the nerve until the latter is clearly defined, pass the aneurism needle beneath the nerve from above downwards being specially careful to include the uppermost or dorsal twigs, and passing a curved probe pointed scalpel or one blade of a pair of scissors underneath it, divide the nerve at the foramen, grasp the free end with compression or other forceps and excise a piece at least 3 cm. long including all branches. Cleanse the wound, sprinkle with iodoform and close with continuous sutures. Place the square piece of muslin centrally over the wound and fix it securely to the skin by means of a strong suture at each corner, in order to protect the wound while the other nerve is being cut. Turn the animal to the opposite side and repeat the operation on the other nerve except the square piece of muslin which is here unnecessary. As soon as the animal stands, remove the protective piece of muslin from the first wound, disinfect wounds and leave undisturbed to heal by primary union. Avoid halter, bridle or other fixtures which might injure the wounds after operation.

OPERATIONS ON THE NECK.

OPENING OF THE GUTTURAL POUCHES.

Fig. 9.

Instrumeuts. Razor, scissors, convex pointed, and straight probe pointed scalpels, mouse-toothed and ligation forceps, tenacula, probe, trocar, curette, drainage tubing, needles, thread, absorbent cotton.

Technique. 1. *Viborg's method.* The operation is possible on the standing animal. By extending the head and compressing the jugular vein there is brought out the triangle immediately behind the posterior border of the inferior maxilla and beneath the parotid gland comprised between the posterior angle of the inferior maxilla the terminal tendon of the sterno-maxillaris muscle and the external maxillary vein. In this so-called Viborg's triangle after the removal of the hair and the disinfection of the skin which is maintained stretched, make a 5 cm. long incision through the skin and skin muscle immediately beneath the aforementioned tendon and parallel to it. It can also be done when tense swelling is not present by raising a fold of skin 2½ cm. high. In case of pronounced swelling in Viborg's triangle the operator must determine his location for operating by the position of the sterno-maxillaris muscle. Then force a passage with the finger [or with blunt scissors or other blunt instrument] through the loose connective tissue in the area which is free from nerves and vessels on the inner or median side of the parotid gland and of the stylo-maxillaris muscle to the guttural pouch and force a passage through it at its lowest point with the finger or a trocar. In order to open the empty guttural pouch it is desirable to grasp it by means of forceps. Through the operative wound a drainage tube can be introduced into the pouch, which can be fixed in its

position and prevented from slipping in or out by suturing to the edges of the cutaneous wound. [In abscess of the sub-parotid lymph glands the operation is identical with

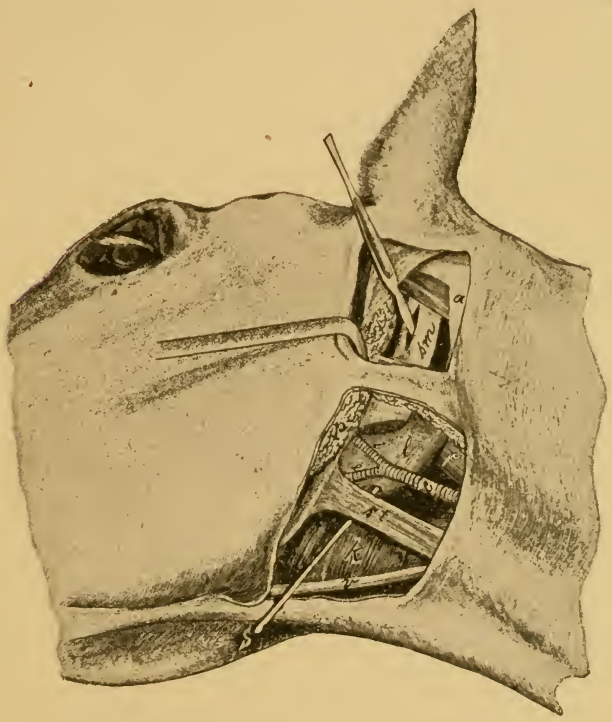

FIG. 9.—Head and neck of recumbent horse viewed from the side. Opening of the guttural pouches (Hyovertebrotomy) according to Viborg and Chabert. *sm*, Stylo-maxillaris muscle ; *p*, parotid gland ; *l*, guttural pouch ; *k*, larynx ; *st*, sterno-maxillaris muscle ; *r*, rectus capitus anticus major muscle ; *c*, external carotid artery ; *e*, external maxillary artery ; *i*, internal maxillary artery ; *v*, external maxillary vein ; *s*, probe ; *a*, wing of atlas.

the foregoing only that the abscess has pushed the lateral wall of the pouch far inwards (medial) so that the pouch itself is not opened nor reached.]

2. *Chabert's method.* Secure the horse in the lateral recumbent position, remove the hair and disinfect the skin beneath the wing of the atlas. Make an incision about 1 cm. in front of the lower half of the wing of the atlas and parallel to it, about 6 cm. long extending through the skin and skin muscle down to the parotid gland. The incision is facilitated by rendering the skin tense with the left hand and care is to be taken not to wound the auricular nerve which passes directly along the atlas. Then draw backward the posterior border of the wound and separate with blunt instruments the posterior border of the parotid gland from the atlas to which it is bound by loose connective tissue and draw the parotid gland forward with tenacula. At the bottom of the opening thus formed there is seen the stylo-maxillaris (digastricus) muscle lying against the median side of the parotid gland covered only by the aponeurosis of the mastoido-humeralis muscle. With the handle of the scalpel inclined toward the wing of the atlas penetrate in the direction of their fibers the aponeurotic expansion of the mastoido-humeralis muscle and the sterno maxillaris muscle. The puncture is thus located between the ninth and tenth nerves on one side and the internal carotid on the other. Since the wall of the guttural pouch rests against the median side of the digastricus muscle the pouch is opened by this incision. The operator inserts an index finger along the blade of the knife at first and after withdrawal of the knife the other index finger also in the punctured wound and by forcibly parting these dilates it. The abnormal contents are then removed by means of forceps, curetting and irrigation. In order to prevent adhesion of the firmly stretched stylo-maxillaris muscle, introduce a strong drainage tube into the pouch and fix it to the external borders of the wound by a suture.

3. *Dieterich's method.* This combines the operations under 1 and 2, with the difference that the superior opening of the pouch is made immediately behind the stylo-maxillaris.

In order to accomplish this the cutaneous wound over the wing of the atlas must be prolonged below it. After detaching the posterior border of the parotid gland the operator searches in the loose areolar tissue with the index finger of the left hand for the vascular angle which is formed by the occipital, internal carotid and external carotid arteries which may be detected by pulsation—the same is located at a depth of somewhere from 8 to 10 cm. Place the volar surface of the finger in the vascular angle and push a sharp scalpel along the dorsal surface of the finger to the pouch which here becomes opened on its posterior lateral surface.

This method has the advantage over Chabert's that for the removal of hard contents (chondroid) the opening can be readily dilated, even to such an extent that the entire hand can be passed into the air sac and the opening of the Eustachian tube be explored.

TRACHEOTOMY.

Fig. 10.

Instruments. Razor, scissors, convex scalpel, tenacula, tenaculum and ligation forceps, trachea tube and suture material.

Technique. In the superior third of the neck in the region of the fourth to the sixth tracheal ring shave and disinfect the skin on the anterior surface of the neck to the extent of 10 cm. long by 5 cm. wide. The operation can generally be performed upon the standing animal with the head extended. In lateral decubitus of the horse the operation is carried out with greater difficulty. The operator stands before the right, an assistant before the left shoulder of the horse. On the shaved area the operator and his assistant takes up a fold of skin 3 to 4 cm. high, transverse to the long axis of trachea, and divides the same by an incision. The 6 to 8 cm. long skin wound then lies in the median line of the anterior face of the neck. After the skin muscle is cut

through, in order to avoid hemorrhage separate the two sterno-thyro-hyoideus muscles, by means of tenacula, along the median line in the white strip of connective tissue.

The trachea which is now laid bare is slit from below upward through three or four tracheal rings if the operation is to be performed without loss of substance. By the method

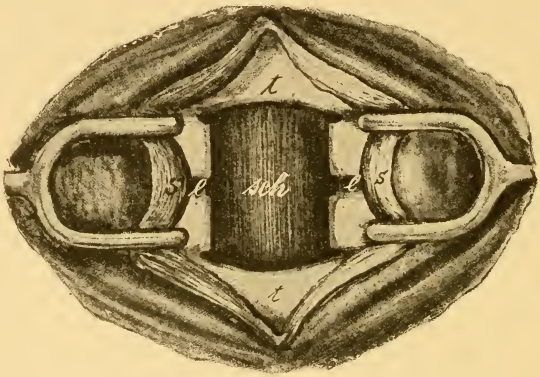

FIG. 10.—Tracheotomy. *s*, Sterno-thyro-hyoïdens muscle ; *t*, trachea ; *sch*, mucous membrane of the posterior wall of the trachea ; *l*, interannular ligament.

with loss of substance penetrate at the lower angle of the wound, transversely, the lowest inter-annular ligament, elongate the incision to the right and left, make a vertical incision on each side upwards through one or two tracheal rings, grasp the partially detached portion of trachea with forceps and cut it out by means of an incision through the inter-annular ligament, which now constitutes the only union with the trachea. According to the size of the trachea tube and the width of the tracheal rings one or two tracheal rings are removed. The outer canula of the tube is now introduced into the trachea directed upwards, the inner inserted through the first and screwed fast to this with the thumb screw. If the cutaneous incision is too long, occlusive sutures should be inserted through the skin above and below the trachea tube.

INTRA-TRACHEAL IRRIGATION.

[For dislodging septic or irritant substances from the trachea and bronchi.]

Instruments. Same as for tracheotomy, and a gravity irrigating apparatus fitted with 3 m. of rubber tubing about 1 cm. diameter, 5 liters of .6 per cent. soda bicarbonate or chloride solution at a temperature of 37 @ 39° C.

Technique. Operate on standing animal. Perform tracheotomy. Elevate the gravity apparatus containing the irrigating fluid 1 to 2 m. above the patient, have the animal's head slightly elevated, insert the free end of the rubber tubing in the trachea tube and let the fluid flow into the trachea in a moderate stream until it is filled and the animal makes explusive efforts, when the inflow is stopped and the animal permitted to lower his head and expel the fluid, then raise the head again and repeat until the fluid is expelled clear. Repeat the operation according to requirement. In cases of suppurative bronchitis, peroxide of hydrogen should be added to the solution.

ARYTENOIDRRAPHY.

[Merillat's operation for the cure of "Roaring."]

Fig. 11, 12, and 13.

Instruments. Scalpel, curved needle, strong suture of braided silk 1 m. long, retractors, long handled needle holder, long tenaculum, angular or curved scissors, and haemostatic forceps.

Technique. Cast the patient and anaesthetize, and place and retain in the dorsal position with the head extended to the maximum on a straight line with the long axis of the body.

1st. Make a longitudinal incision through the skin and underlying muscles from the base of the thyroid cartilage to the anterior margin of the first tracheal ring, dilate the

wound with retractors and control all hemorrhage before proceeding further.

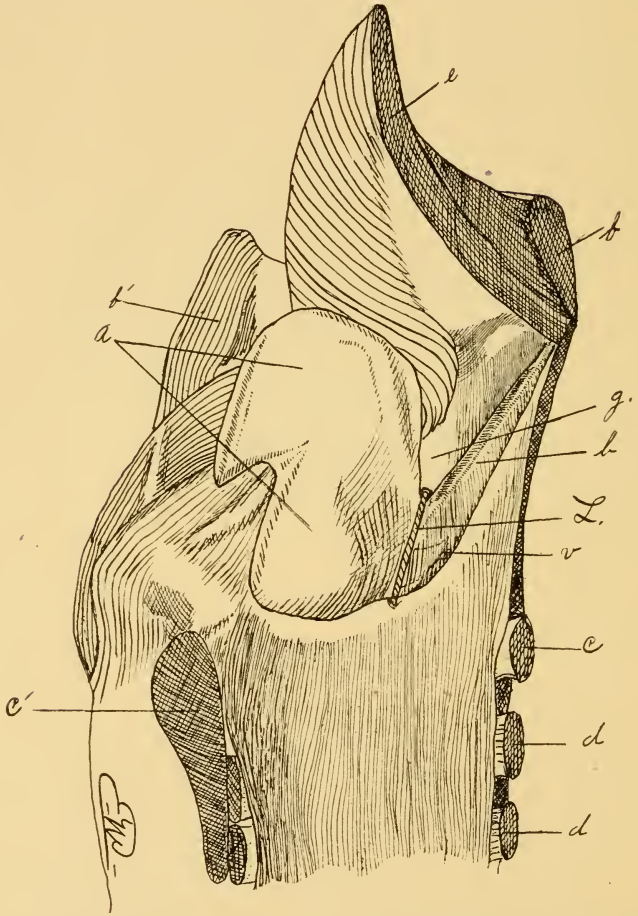

Fig. 11.—Median longitudinal section of the larynx, showing location of the ligature in arytenoidrraphy (diagrammatic). *a*, The left arytenoid cartilage; *b*, left vocal cord; *c*, cricoid cartilage; *c'*, bezel of cricoid cartilage; *d*, *d'*, tracheal rings; *e*, epiglottis; *f*, base of the thyroid cartilage; *f'*, left ala of thyroid cartilage; *g*, supraglottal sinus; *v*, dotted lines representing vocal process.

2nd. Laryngotomy. There is now exposed to view, from before backward, the crico-thyroidean membrane, the constricted portion of the cricoid cartilage, and the crico-

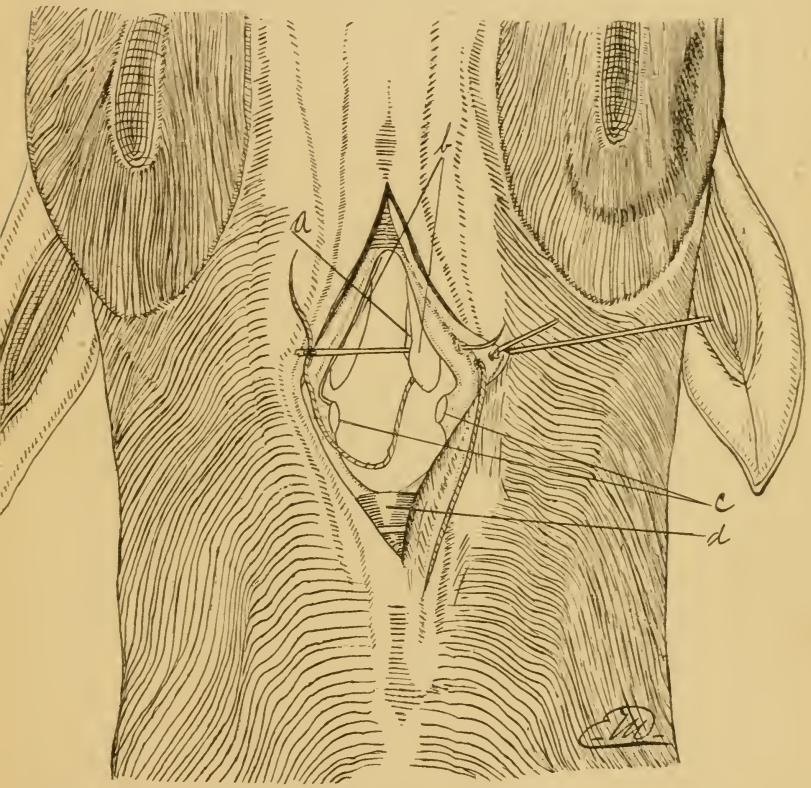

FIG. 12.—The third step of arytenoidrraphy (diagrammatic). *a*, Left arytenoid cartilage; *b*, vocal cords; *c*, the cricoid cartilage; *d*, the first tracheal segment.

tracheal ligament. Pass a scalpel into the larynx through the crico-thyroidean membrane just behind the base of the thyroid with cutting edge directed backward and cut

through the above named structures. The bleeding is again controlled and especially a small vein related to the anterior margin of the cricoid cartilage.

3rd. The incision is now gently dilated with the retractors in order to inspect the laryngeal cavity. Forcible or even moderate traction with the retractors must be avoided so as to prevent unnecessary injury to the cricoid cartilage. (It is evident from recent observations that the injury done to

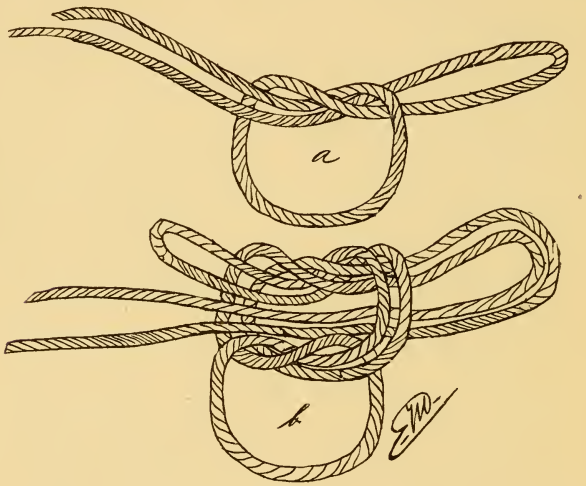

FIG. 13.—Knot used in ligating arytenoid cartilage in arytenoidrraphy. *a*, First tie ; *b*, knot completed.

the cricoid cartilage by forcible dilatation of the opening is frequently the actual cause of its collapse.)

The threaded needle is now passed through the space between the cricoid and thyroid cartilages, from without inward to a point just behind the vocal process of the arytenoid (Fig. 11) and is directed back to the point of entrance from a point just in front of the vocal process beneath the vocal cord. The arytenoid cartilage is now pressed against the lateral wall of the larynx while an

assistant draws the ligature tight and ties it by a knot consisting of two hitches, each of which is a bow and which can be completely loosened by pulling the cut ends (Fig. 13). If the ligature is tied by any of the ordinary knots it will be necessary to again cast the patient at the time of its removal ten days later.

4th. The parts around the ligature are now slightly wounded so that the resulting cicatrix will hold the arytenoid cartilage in place after the ligature is removed. This wounding consists of an incision through the mucous membrane along the posterior border of the arytenoid and a resection of 2 cm. of the vocal cord beginning .5 cm. from the ligature. Return the patient to the lateral recumbent position to revive from the anaesthetic. No form of intubation or tamponing that will forcibly dilate the incision is admissible.

After-care. Apply antiseptics to the superficial parts of the wound. In ten days the ligature is untied and gently pulled out. Alarming dyspnœa may occasionally occur from tumefaction of the laryngeal mucous membrane, at any time during the first four days following the operation. Usually this condition can be met by simply dilating the dermal incision by means of sutures passed through each edge of the wound and tied at the poll, but when this fails tracheotomy must be resorted to. It is never advisable to insert a tube through the original incision.

INTRAVENOUS INJECTION.

Fig. 14.

Instruments. Scissors, hypodermic syringe.

Technique. The operation is performed on the standing horse on the right jugular vein at the juncture of the upper and middle thirds of the neck. At this place the subscapulo-hyoïdeus muscle lies between the jugular vein and the

carotid artery. After clipping the hair, the skin should be carefully disinfected. The vein lies in the jugular groove between the mastoido-humeralis and the sterno-maxillaris muscles covered only by the skin and cervical panniculus carnosus muscle. The operator stands by the right shoulder of the horse and compresses the jugular with the thumb of the left hand (Fig. 14) or with second to fourth fingers of the left hand, in which case the ball of the thumb rests upon the mastoido-humeralis muscle, in such a way that the vein becomes filled above the point of compression in the shorn

FIG. 14.—Intravenous injection.

area so that it stands out like a swollen cord. In case of fleshy necked horses this compression is more readily attained if the animal's head is somewhat extended and elevated by an assistant. If the vein cannot be made prominent in this way the compression should be alternated suddenly and repeatedly ; the course of the vein then reveals itself by a wave-like movement which runs along the jugular groove from above to below. Just above the point of compression the vein is most fully distended and is here also

most firmly fixed. After testing the hypodermic needle to see that it is open, insert it just above the point of compression, through the skin, cutaneous muscle and jugular wall in the direction of the vein from behind and below, forwards and upwards 1 to 2 cm. deep, so that the point of the needle enters the vein at its most distended part. In this way it is easy to prevent injury to the median wall of the vein. The needle is held between the second and third fingers of the right hand while the thumb covers its posterior opening. If the vein has been properly punctured blood will flow from the needle upon the removal of the thumb. In this case the compression is removed, the left hand grasps the needle, the right connects the hypodermic syringe, in which no air is contained, and slowly discharges the contents of the syringe. In withdrawing the needle be careful to press the skin firmly against the underlying part. The omission of this precaution frequently results in the formation of a subcutaneous extravasation of blood. If the vein is not entered at the first attempt the needle should be partly withdrawn and then pushed in again in a slightly different direction.

For venesection a hollow needle 5 mm. in diameter is used.

VENESECTION.

Instruments. Razor or scissors, fleams, lancet, phlebotomy trocar, spring lancet, pin, thread or suture material.

Technique. I. Phlebotomy with fleams is performed on the left jugular vein with the horse standing. The point of operation is the boundary line between the upper and middle cervical regions, because it is here that the subscapulohyoideus muscle which separates the jugular vein from the carotid artery is most voluminous. At this point the skin is shaved or clipped and disinfected. The extended blade of the fleam is grasped at the joint with the thumb and index finger of the left hand, while the third and fourth

fingers of the left hand compress the jugular vein at a point far enough below the shaved part that the fleam blade rests upon it. In fleshy necked animals the course of the vein may be clearly made out by repeated distension and relaxation of the vein. It is well to be careful that the point of the fleam blade is not allowed to prick the skin prematurely as it causes restlessness of the animal ; and that the fleam blade is held perpendicular and parallel to the axis of the vein. The most elevated point of the distended vein should be struck by the knife in such a way that the skin, subcutaneous muscle and jugular wall are penetrated parallel to the axis of the vein. Drive the fleam blade into the vein by a short, sharp blow with the extended right hand or a light wooden stick. The extension on the fleam blade prevents its being driven too deeply. The size of the blade to be used depends upon the thickness of the skin, etc. If the vein is struck, dark red blood escapes from the wound in a large stream. Lay the instrument aside with the right hand, while the fingers of the left hand continue the compression of the vein without interruption, in order to prevent aspiration of air into the vein, and also that the lips of the skin and vein wounds shall not become overlapped by which the escape of blood would be impeded. The escape of blood may be favored by inducing masticatory movements by the horse. The amount of blood to be withdrawn varies between three and four liters, according to the size of the animal and the object to be attained. The closure of the fleam wound is brought about either by an interrupted suture or a pin suture. For this purpose the compressing fingers of the left hand are relieved by the thumb of the right, the wound of the skin is grasped by the left index finger and thumb, the finger above, the thumb below, and the pin is stuck perpendicularly through the middle of the skin wound, a few mm. from the borders of the wound. Now that both hands are released a noose of silk thread previously prepared is applied over the pin and the loop closed

and tied. In applying the loop, care is to be taken to not elevate the skin from the underlying parts. If the operation does not succeed at the first effort, one should select an undamaged portion of skin for a second attempt.

II. With the lancet the operation is performed on the right side of the neck. In both operations the operator stands near the horse's shoulder. The vein is compressed as illustrated in Fig. 14. The lancet is held between the thumb and index finger of the right hand with the blade at right angles to the handle, the thumb and finger being so placed on the blade that the latter can barely penetrate the vein, and the instrument is then pushed in just in front of the left thumb through the skin subcutem and venous wall as deep as the fingers holding the lancet will permit. The blade must be held perpendicular to the axis of the vein, the point must not be directed backward (dorsalwards). The wound in the vein is then slit upward somewhat (toward the head) by dorsal flexion of the hand. In cattle the vein is compressed by means of a cord tightly drawn around the neck, and the operator takes a position for his own safety and convenience beside the animal on the side where the operation is to be performed, while an assistant holds the animal by the horns, [or nose]. The closure of the phlebotomy wound occurs in a similar manner as in I., only with the modification that the thumb and second finger of the right hand grasps the cutaneous wound from before and the needle is pushed through the lips of the wound by the left hand with the aid of the right index finger.

III. With the trocar the operation is performed in the same manner, as has been described for intravenous injection. So long as the flow of blood continues the compression of the vein must not be intermitted.

LIGATION OF THE CAROTID.

Figs. 15 and 16.

Instruments. Scissors, scalpels, tenacula, mouse-toothed forceps, ligation forceps, thread, suture material.

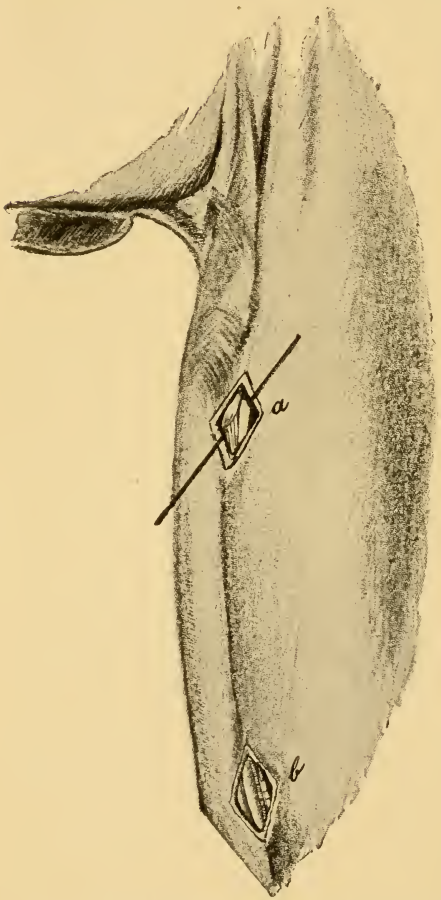

FIG. 15.—*a*, Ligation of the common carotid artery; *b*, œsophagotomy.

Technique. The operation may be carried out with the animal standing or cast. The operation is made at the same point as for phlebotomy and the same cutaneous wound may be used for this purpose. The incision should be at least 10 cm. long extending through the skin, the skin muscle and finally the subscapulo hyoideus muscle and then a passage forced with the fingers, with the cautious aid of the knife, to the trachea. At the juncture of the upper and middle thirds of the neck the carotid artery passes along the border between the lateral and dorsal surfaces of the trachea, accompanied dorsally by the vagus

and sympathetic nerves and ventrally by the recurrent nerve. Pass the index finger over and behind the carotid until it rests upon the trachea encircling the inner and lower sides of the carotid, force a way through the surrounding tissue and

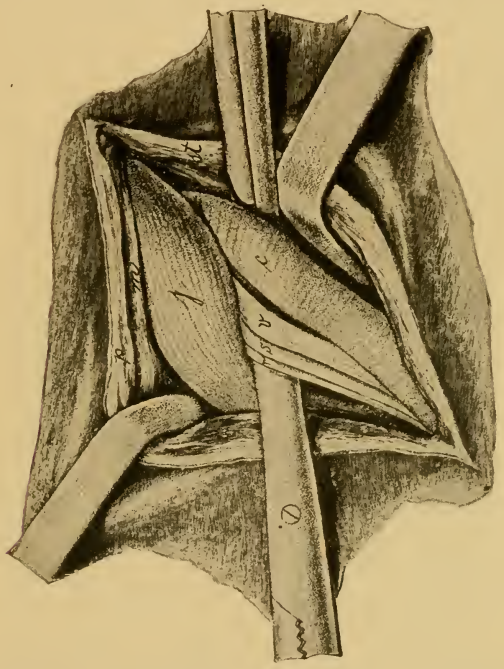

FIG. 16.—Ligation of the common carotid artery. *c*, Common carotid artery; *j*, juglar vein; *v*, vagus nerve; *r*, recurrent nerve; *p*, cervical panniculous carnosus muscle; *m*, sterno-maxillaris muscle; *st*, levator humeri muscle.

draw the carotid out through the operation wound. As a rule the carotid is still surrounded by the lamellar fascia, which comes from the deep fascia of the neck in which also the three above mentioned nerves are found. After these have been carefully separated the carotid is ligated twice on account of its collateral anastomoses and severed in

every case between the two ligatures. By this means we avoid rupture of the artery at the point of ligation where the nutrition has been cut off, through the stretching of the undivided carotid in movements of the neck. Drain and suture the skin and muscle wounds.

ŒSOPHAGOTOMY.

Figs. 15 and 17.

Instruments. Razor, scissors, convex scalpel, straight probe pointed scalpel, tenacula, artery and ligation forceps, thread, absorbent cotton, suture material.

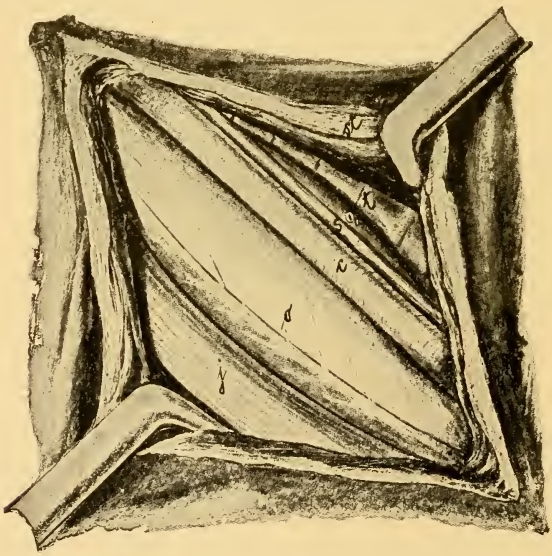

FIG. 17.—Œsophagotomy. *c*, Common carotid artery; *j*, jugular vein; *o*, *o'*, œsophagus; *s*, sympathetic nerve; *t*, trachea; *st*, mastoïdo humeralis (lavator humeri) muscle.

Technique. The operation can be carried out on the standing or lying animal, on the left side of the neck, because the

œsophagus lies on the left side of the trachea in the lower half of the neck. When the œsophagus is empty the operation is performed in the lower third of the neck. An incision 10 cm. long through the skin and skin muscle is made between the anterior border of the mastoido-humeralis muscle and jugular vein. With one finger each of the left and right hand divide the loose connective tissue down to the œsophagus, which lies between the left scalenus muscle, trachea and the jugular vein. Along the supero-external border of the trachea runs the carotid accompanied dorsally by the vagus and sympathetic and ventrally by the recurrent nerves. The œsophagus feels like a round muscle within which one can feel a firmer cord (mucous membrane), and has a pale red color. Œsophagus and trachea are surrounded by the deep fascia of the neck. Pass one finger around the œsophagus from behind, draw it away from the trachea, force through the deep fascia of the neck and draw the œsophagus out through the external wound. After making an incision through the muscle and mucous membrane introduce a probe pointed scalpel or a scissors blade into the lumen of the œsophagus and split its wall. The mucous membrane is white and lies in thick longitudinal folds. When there is a foreign body in the œsophagus the operation is performed at the point where it is lodged in the manner described and the œsophagus is opened barely enough to permit of the removal of the foreign body. In diverticuli of the œsophagus an elliptical piece of the mucous membrane which has been overstretched is cut out. The œsophageal wound is closed by a laminated suture, that is, the mucous membrane is united by means of an intestinal suture and the muscular wall sutured over this. The skin and muscular wound may either be left open or closed with the Bayer suture and bandaged, with a drainage tube in the lower angle of the wound.

OPERATIONS ON THE TRUNK AND GENITAL ORGANS.

PUNCTURE OF THE CHEST.

Fig. 18.

Instruments. Razor, scissors, chest trocar, vessel for receiving the escaping fluid, dressing material.

Technique. The operation is performed upon the standing animal, which is held against a wall, the point of operation being the seventh intercostal space on the left side, and the sixth on the right. Dogs may be laid upon a table.

FIG. 18.—Puncture of the thorax ; puncture of the intestine.

The ribs are enumerated from behind forward counting eighteen to the horse and thirteen to the dog. Clip or shave the hair and disinfect the skin immediately above the thoracic vein. Hold the trocar with the handle in the hollow of the right hand with the index finger on the instrument as in writing with a pen, sufficiently extended that

the point of the trocar projects beyond it barely enough to penetrate the thoracic walls (4 to 6 cm). After the skin over the seat of operation has been drawn aside by the left hand place the trocar at the anterior border of the rib slightly inclined forward and push it with a sharp thrust through the skin, skin muscle, intercostal muscles, internal thoracic fascia and pleura into the pleural sac. As soon as the resistance ceases, the thoracic cavity has been entered. The stilette is now withdrawn and the existing fluid which may be pus, blood, serum, etc., escapes. While this escape is at first continuous, it later becomes rhythmic, synchronous with expiration. The intermission of the outflow during inspiration permits, with the ordinary trocar the entrance of air into the chest cavity. This occurrence may be avoided by closing the canula with the finger after each expiration of the animal. The pneumothorax is best prevented by using Billroth's trocar. [The same result may be attained with an ordinary trocar by passing a piece of rubber tubing over the canula and dropping the free end in the vessel receiving the escaping liquid.] If the outflow becomes entirely interrupted introduce the stilette and remove the occluding substance, usually fibrinous clots, from the canula. To remove the instrument, introduce the stilette into the canula, press the skin against the chest wall with the left hand and draw the trocar out promptly. As the displaced skin resumes its normal position the puncture is hermetically sealed. The outer opening may be covered with iodoform collodion.

PUNCTURE OF THE INTESTINES.

Fig. 18 and 18a..

Instruments. Razor, scissors, lancet, intestine trocar, dressing material.

Technique. Puncture of the intestine is performed in the

right flank on the standing horse, 10 cm. in front of the external angle of the ilium and the same distance below the tranverse processes of the lumbar vetebræ, that is, at the most prominent part of the distension. After the skin at this place has been clipped or shaved, disinfected and displaced toward the external angle of the ilium, make a small puncture through the skin with a lancet and then with the trocar held in the hollow of the right hand push it with a strong thrust through the skin, tendinous expansion of the subcutaneous muscle, the external and internal oblique and transverse abdominal muscles, subperitoneal fat and peritoneum, in the direction of the elbow of the left side, enter-

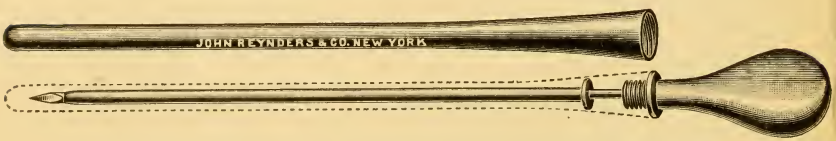

FIG. 18*a*.—Intestine trocar with sheath. Outside diam. of canula 3 mm., length of canula 16 cm.

ing the base of the cæcum and introducing the trocar to the ring on the canula. After the withdrawal of the stilette the evacuation of the gas occurs at times intermittently owing to collapse of the intestine. Occlusion of the canula is to be overcome by introducing the stilette.

When removing the trocar canula, in order to prevent the dropping of food particles out of the canula into the peritoneal cavity, replace the stilette, press the skin against the abdominal wall with the left hand and remove the trocar with a spiral motion. The external opening may be closed with iodoform collodion. [We very much prefer a much smaller trocar than is generally sold by dealers for the purpose, the canula being 3 mm. outside diameter by 16 cm. long. The triangular point of the stilet is much elongated (12 mm.) furnishing a cutting edge almost equal to a lancet, the incision with which latter is thus dispensed with, the

skin is not displaced, the trocar is held loosely by the canula in the left hand and a smart blow struck on the handle with the palm of the right hand driving the instrument through into the intestine. The wound being much smaller than with lancet, and closing at once, requires no after care.]

SUBCUTANEOUS CAUDAL MYOTOMY.

[Operation for Curved Tail.]

Fig. 19.

Instruments. Sharp straight tenotome, bandage.

Technique. The point or points of curvature and their extent are to be carefully noted by having the animal trotted away from the operator. The curvature is generally due to

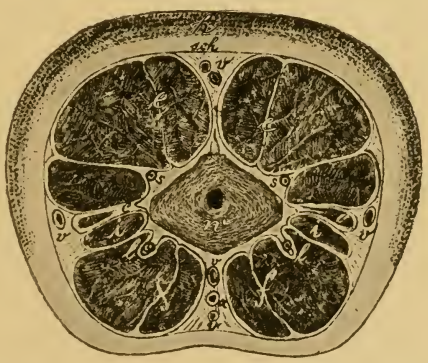

FIG. 19.—Transverse section of the tail. *n*, Caudal vertebra ; *c*, sacro-coccygeus lateralis muscle ; *e*, sacro-coccygeus superior ; *f*, depressor longus and brevis muscles (sacro-coccygeus inferior) ; *i*, intertranversales muscles ; *a*, coccygeal artery ; *s*, supero-lateral coccygeal artery ; *l*, infero-lateral coccygeal artery ; *v*, caudal veins (dorsal, ventral, lateral) ; *sch*, caudal fascia ; *h*, skin.

unequal development of the two levator or extensor muscles (Fig. 19 *e*), though quite rarely the depressors (Fig. 19 *f*) may be implicated. Confine the animal in stocks, or in

default of these, control by means of twitch and sideline. Cleanse and disinfect the tail and have it sharply bent by an assistant in the opposite direction to the curvature. Locate the longitudinal furrow between the levator and depressor muscles and at the lower margin of the levator just above *v*, Fig. 19, insert the tenotome at the most prominent part of curvation, the incision being parallel to the muscular fibers, and push the tenotome entirely through the muscle to the vertebra, then turning the cutting edge upwards, at the same time advancing the point of the tenotome toward the median line, sever the entire muscle. The superior lateral caudal artery *s*, Fig. 19, bleeds profusely if severed, and wounding of it may usually be avoided by withdrawing the tenotome a trifle in passing that point. Wounding the skin over the muscular incision is avoided by placing the thumb of the left hand over the line of incision so the knife will be recognized as soon as the muscle and caudal fascia are cut through. Remove the knife in the same manner as introduced. Release the horse and have him trotted again. If the operation is sufficient the tail should curve in about the same degree as before, but in the opposite direction. If this has not been attained examine carefully and sever any remaining bundles of muscle, and this not sufficing repeat the operation as before at another point 5 or 6 cm. above or below the first, severing the muscle again. Or if the depressor appears implicated, sever it in a similar manner. In extreme cases the entire lateral half of muscles, tendons and aponeurosis may be severed. Apply an antiseptic pad to the wound and retain it by a moderately firm bandage, which serves at once as an occlusive dressing and effective hemostatic. Remove bandage in 24 hours.

CAUDAL MYECTOMY.

[To prevent gripping of the reins].

Fig. 20.

Instruments. Elastic ligature, straight bistoury, tenacula, absorbent cotton, bandages, disinfecting material.

Technique. Confine the animal in lateral decubitis or in stocks, cleanse and disinfect the tail, apply the elastic ligature as close as possible to the root of the tail and have an assistant hold the tail extended upwards (*i. e.* dorsalwards) and tightly stretched. Make an incision 15 to 20 cm. long,

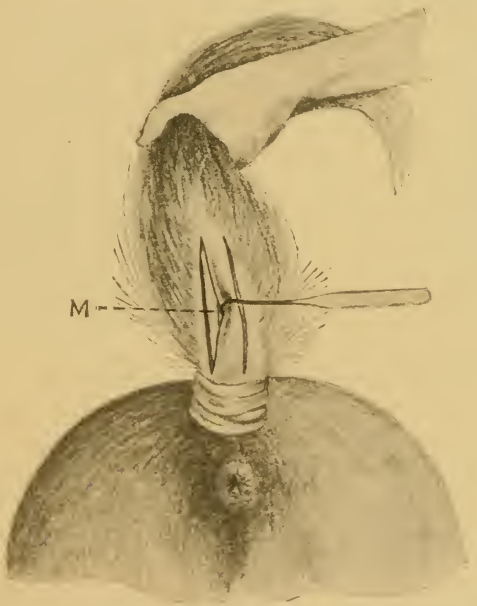

FIG. 20.—Caudal myectomy. *M*, Depressor longus muscle.

over the middle of the inferior surface of one depressor longus muscle, beginning close against the elastic ligature and extending toward the tail, severing at once the skin and caudal fascia down to the muscle. Let an assistant

dilate the incision with tenacula while the operator dissects the depressor longus muscle from the adjacent tissues at either side when it is severed by a transverse incision close against the ligature and the entire muscle dissected away down to the lower end of the wound and there excised. The small depressor brevis, lying on the median side of the longus, should not be removed, thus preserving a limited depressor power. Repeat the operation on the opposite depressor. Make two elongated tampons of absorbent cotton, of the size and form of the muscles removed, saturate these in 1–1000 sublimate solution, insert neatly in the wounds and apply a moderately firm bandage as closely as possible to the elastic ligature. Remove the ligature, upon which hemorrhage ensues, which is to be controlled by the application of a second bandage extending higher up on the tail over the previous location of the elastic ligature. Remove bandage in 24 hrs. wash the parts and saturate the tampons again with 1–1000 sublimate and apply a clean bandage, allow it to remain for another 24 hrs. remove bandage and tampons and treat as an open wound.

AMPUTATION OF THE TAIL.

Fig. 19 and 21.

Instruments. Docking shears, ring cautery iron.

Technique. The operation is carried out on the standing animal with the aid of the twitch and one fore foot held up or side line applied to the hind feet. The point of amputation is determined by the location of the disease or the wishes of the owner. At this point the hair is parted around the tail, turned upwards and bandaged to the root of the tail with a compression bandage (not a cord) which at the same time serves to make the operation bloodless. Then beneath the part clip the hair away for a space of 3 to 4 cm. around the tail, have an assistant hold the tail hori-

zontally, stand at the side behind the left leg and apply the docking shears in such a way that the clipped portion of the dock rests in the semi-circular depression in the shears. By quick and powerful closing of the handles of the docking

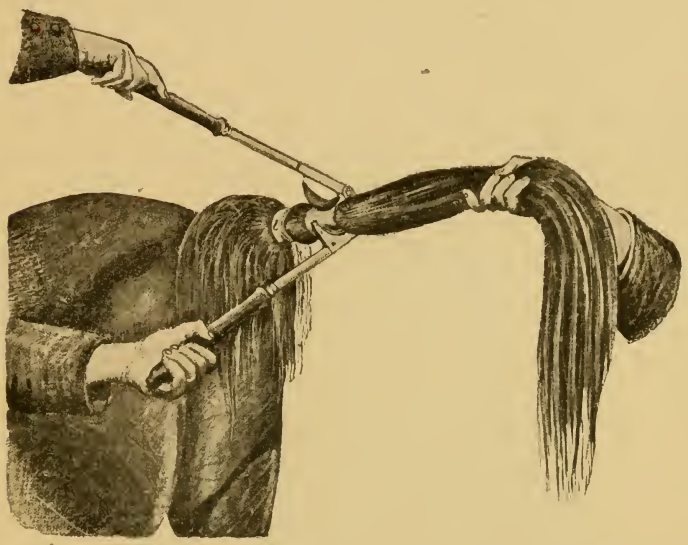

FIG. 21.—Amputation of the tail. *l*, Ligature for binding the hair of the tail upwards.

shears cut, if possible, between two caudal vertebrae at one stroke the skin, the fibrous fascia of the tail, the dorsally located levator, the ventrally located depressor, the curvator, the inter-transversales muscles with vessels and nerves, and the inter-articular cartilage. Grasp the stump of the tail with the left hand and press the red-hot ring iron against the parts between the skin and vertebrae for from ten to twenty seconds in order to stop the hemorrhage so that a dry and firm necrotic scab covers the wound surface. In cattle and dogs the tail is amputated in a similar manner between two

vertebrae ; a straight knife will answer for operating instrument. Hemorrhage is likewise most promptly controlled by cautery. Ligating the arteries and applying bandage is more æsthetic.

URETHROTOMY.

Fig. 22 and 23.

Instruments. Catheter, convex scalpel, scissors, artery and compression forceps. tenacula, lithotome, lithotomy forceps, lithotrite, absorbent cotton, drainage tube, suture material.

Technique. Urethrotomy may be performed on horses in a standing position, the hind feet being secured with hobbles. If this is not practicable, the animal is carefully cast, after the urinary bladder has been empted, if possible, and

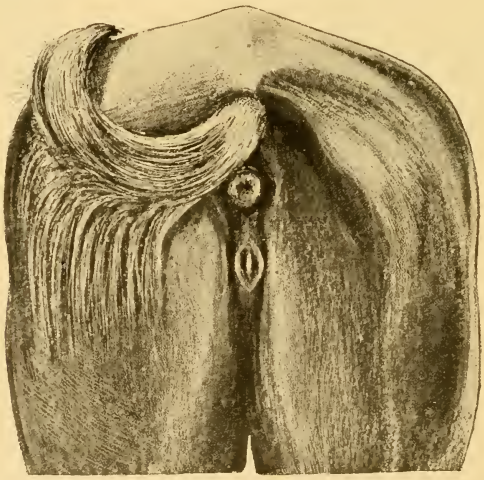

FIG. 22.—Urethrotomy at the ischial notch.

by preference the animal should be p'aced in dorsal decubitis. The point of operation will depend on the location of

the calculus. If it is found in the pelvic portion of the urethra or in the bladder, the operation is made at the ischial notch. First the penis is drawn out from the prepuce and the catheter introduced into the urethra and pushed upward until it has passed the ischial notch. After disinfection of the skin, render it tense and make a 5 cm. long incision in the median line at the ischial arch through the skin, bulbo-cavernosus muscle, spongy portion of the

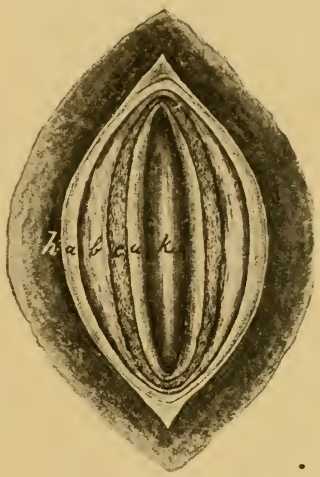

FIG. 23.—Urethrotomy (life size). *h*, Skin; *a*, retractor penis muscle; *b*, bulbo-cavernous muscle; *c*, spongy urethra; *u*, urethra; *k*, catheter.

urethra, and the urethral mucous membrane down to the catheter. In order to prevent infiltration of urine after the operation, special care is to be taken to make the lower end of the wound slanting in such a manner that the inner wound is shorter than the outer. After the catheter has been drawn back away from the ischial arch, introduce the lithotomy forceps into the urethra or bladder, grasp the stone and draw it outward in its natural direction. The

grasping of the stone by the forceps is materially aided by means of the left hand introduced in the rectum. One must avoid grasping, along with the stone, the mucous membrane of the bladder. By careful rotary movement and pushing the forceps backward and forward the operator can determine before the extraction of the stone if the forceps can be withdrawn easily and without much resistance through the neck of the bladder. If the stone is so large that it cannot pass the neck of the bladder, lithotripsy must be performed. This operation requires time and patience, since as a rule it is not possible to encompass the entire calculus with the forceps. That is, the narrowness of the neck of the bladder prevents the sufficiently wide opening of the forceps. The stone must consequently be gradually broken off at its periphery and the individual pieces of calculus removed. The character of the surface of the stone has an evident bearing upon the practicability of lithotripsy. When this operation is impossible, the operative dilation of the neck of the bladder with the lithotome can be undertaken as a last resort. Introduce the instrument closed into the bladder, it is then opened and the neck of the bladder divided upward and laterally as the instrument is withdrawn. In order to prevent injury to the rectum it should be emptied before the operation is undertaken. After the removal of the stone, push the catheter again over the ischial arch and unite the lips of the wound in the urethral mucous membrane by means of intestinal sutures. Flush the bladder or urethra by means of a warm 3 per cent. boric acid solution injected through the catheter and then withdraw the latter. Finally, suture the skin wound and insert the drainage tube or iodoform gauze in the lower angle of the wound. [For student practice on an anaesthetized horse, introduce a stone into the bladder through the urethral wound and practice grasping and removing it with the lithotomy forceps.]

AMPUTATION OF THE PENIS.

Fig. 24.

Instruments. Elastic ligature, strong silk thread, convex scalpel, artery and compression forceps.

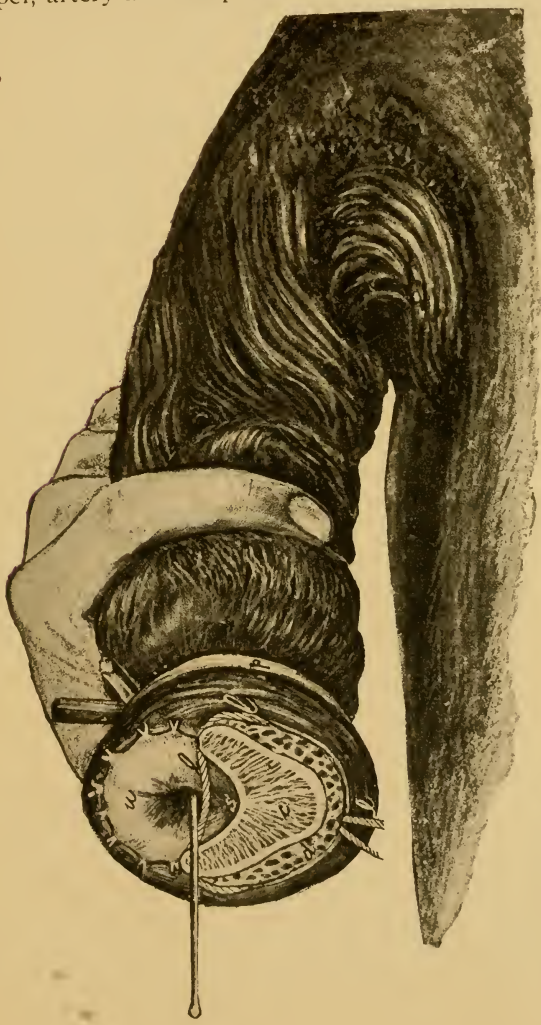

Fig. 24.—Amputation of the penis, the horse being in the dorsal recumbent position. *d*, Dorsal vein of the penis; *c*, corpus cavernosum; *l*, ligature; *p*, provisional ligature; *s*, urethral groove; *u*, urethra.

Technique. The operation is carried out on the recumbent animal, the upper hind foot being released from the hobbles and drawn forward or otherwise so fixed as to not obstruct the field of operation. The point of operation is determined by the character of the disease of the penis and the object to be attained by the operation. If possible amputate in front of the preputial ring. After the penis is drawn out, and the preputial region is carefully cleansed with brush and soap, an assistant grasps the penis just behind the preputial opening with the hand and holds it firmly. A temporary elastic ligature is then applied in front of this hand around the penis and the organ excised by circular incision about 5 cm. in front of the elastic ligature or immediately in front of the preputial ring. The dorsal blood vessels of the penis are ligated separately. The urethra lying on the ventral side of the penis, and which is covered by the corpus cavernosum of the urethra, is dissected out of the urethral groove for a distance of about 2 cm., its dorsal wall slit and the mucous membrane sutured, spread out fan-like to the surrounding tissues. The urethra can also be slit dorsally and ventrally and the one half sutured to the left and the other to the right. A silk ligature is applied to the corpus cavernosum of the penis and the elastic ligature then removed. After a few days the silk ligature is also removed.

VAGINAL OVARIECTOMY.

Figs. 25, 25a, 25b, and 26.

Instruments. Colin's scalpel, ecraseur 55 cm. long.

Technique. Operate on the standing animal. Stocks are *par excellence* the proper means of restraint and are essential to the best results. In absence of stocks other means of restraint may be improvised. Secure the head elevated, prevent arching of the back or rearing, by a rope over the back, prevent lying down by two straps beneath the body,

and movements backward or forward by ropes or straps behind and before the animal ; pinion all four feet and secure the tail tightly stretched upward to a beam.

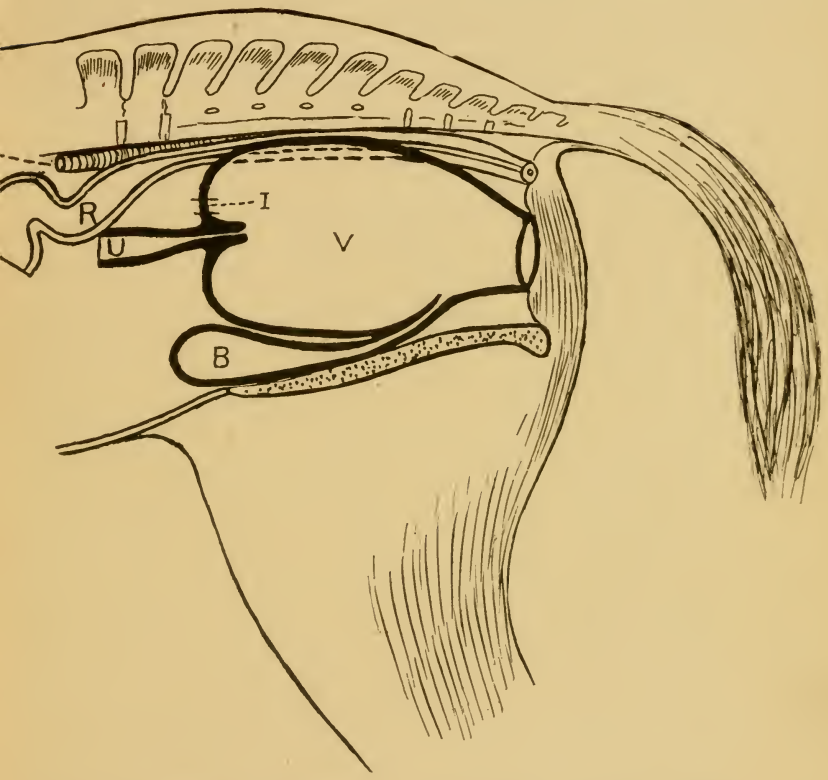

FIG. 25.—Vaginal ovariectomy. Diagrammatic sagittal section through dilated vagina of mare. *A*, Aorta ; *R*, rectum ; *U*, uterus ; *V*, vagina ; *I*, vaginal incision.

With soap, water and brush cleanse the tail, perineum and vulva thoroughly, being especially careful to remove all detachable masses of sebum, 50 per cent. alcohol may be used sparingly to aid in removing the sebum. Too free a

use of alcohol excoriates the delicate skin. Cleanse the clitoris carefully. Follow the washing with a free application of 1 : 1000 aqueous sublimate solution to the external parts and for a short distance (½ cm.) inside the vulvar lips and to the clitoris. Do not introduce disinfectants into the healthy

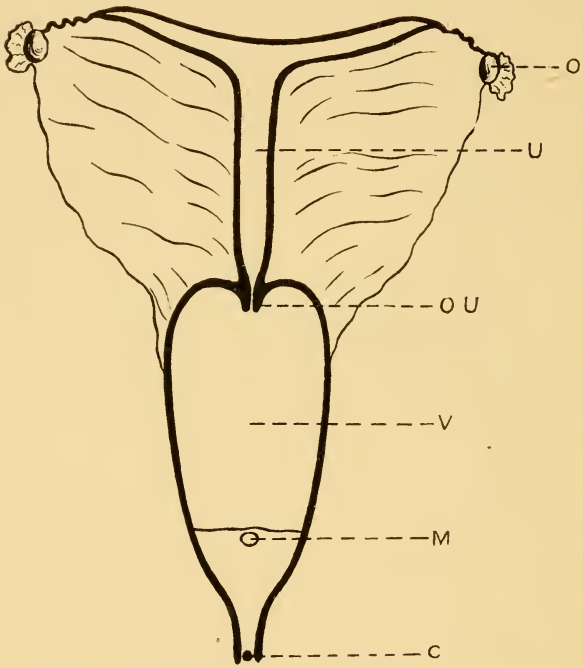

FIG. 26.—Vaginal ovariectomy. Diagrammatic horizontal section of uterus and dilated vagina. *C*, Clitoris; *M*, urinary meatus; *V*, vagina; *O U*, os uteri; *U*, uterus; *O*, ovary.

vagina nor deeply into the vulva as it will cause severe straining during and subsequent to the operation and by injuring the vulvo-vaginal mucosa favor subsequent infection of the vaginal wound. Wash away the sublimate solution with a tepid sterile .6 per cent. soda bicarbonate solution, and fill the vulvo-vaginal canal with the same. After thorough disin-

fection of the hands and arms remove the disinfectants by washing in sterile soda solution, which at the same time renders the hand unctuous and readily introduced through the vulva. Armed with the sterilized scalpel introduce the right hand into the vagina promptly and when the vagina is well "ballooned" unsheath the knife and placing it just above the os uteri (I. Fig. 25) parallel to the long axis of the uterus and a few mm. to the right or left of the median line, the blade being held vertical, that is the cutting surface parallel to the longitudinal muscular fibers of the vagina, and guarding the possible extent of its introduction with the thumb and fingers, push it directly forward in a straight line with a quick thrust through vaginal mucosa, the muscular walls and the peritoneum until the disappearance of resistance indicates that the peritoneum has been penetrated. This is the most critical step in the operation. The vagina of the mare possesses the property of dilating in a remarkable manner like a balloon filled with air, occupying at such times practically the entire pelvic cavity, the rectum collapsed, and the roof of the vagina stretched firmly against the sacrum and in immediate contact with the great pelvic vessels, A Fig. 25, while at the sides and below the vaginal walls are generally in immediate contact with the bony walls of the pelvis. The roof of the vagina, when at rest, is in contact with the floor of the rectum and attached thereto by connective tissue until within 6 to 8 cm. of the os uteri where the two organs are separated by a peritoneal duplicature which constitutes the operative area. This operative area, parallel to the rectum when the vagina is at rest becomes perpendicular to it when "ballooned" so that the operator needs to make his incision directly forward through a tense, thin, perpendicular wall like a drum head. There is in this state no operative area above whatever and an upward incision wounds the rectum and perhaps the posterior aorta or one of the iliac arteries.

If the hand is introduced immediately after the injection of the sterile saline solution the vagina will generally be

found "ballooned" or will quickly become inflated under movements of the hand. If the solution is thrown out, the vagina may collapse and closely invest the hand, in which case more soda solution should be injected when it will again dilate. If the hand is introduced without the knife, withdrawn and then introduced with the knife it will be frequently found that the vagina has collapsed and needs a second filling with the fluid. Patience until dilation is accomplished and promptness to act when attained are prime requisites to success. The knife should be pushed through the vagina quickly making a clean wound the width of the knife blade, when the latter is to be withdrawn and laid aside. It should be remembered that in this "ballooned" state, the anterior wall of the vagina is but 2 to 3 mm. thick and easily penetrated, the completion of the wound being indicated by the sudden disappearance of resistance. Introduce the hand again, insert one finger in the incision, then a second finger, and holding the fingers in the form of a cone push the entire hand into the peritoneal cavity. Immediately below the incision and continuous with the tissues involved in the wound lies the uterus with a transverse diameter of 4 to 6 cm. With the palmar surface of the hand downwards, trace the uterus forward a distance of 15 to 18 cm., where it ends abruptly in two cornua of about the same size as the uterus, which are given off horizontally at almost right angles. Trace these to right and left for a distance of 14 or 15 cm., where they end obtusely, and 3 or 4 cm. beyond this in a direct line, resting upon the anterior border of the broad ligament is the dense oval ovary varying in size from 2.5 to 7 cm. in diameter. Withdrawing the hand, carry the ecraseur enclosed within the hand through the vaginal wound to the region of the ovary, release the ecraseur and retrace the parts if necessary, and locating the ovary drop the chain over the ovary from above and either grasp the ovary with the fingers through the chain loop from above and draw it into the loop or passing one or two fingers around beneath the ovary push it up through the loop to be

grasped by the thumb and index finger above. The chain loop should be of barely sufficient size to admit of the easy passage of the ovary. Holding the ovary with the one hand tighten the chain quickly with the other, examine to make sure that a loop of intestine is not caught, draw the ovary well through and get a large portion of the oviduct, and cut off promptly, holding to the ovary until carried out through the vulva. Remove the other ovary in the same way. Generally it is most convenient to remove the left ovary with right hand and vice versa, but both may be removed with either hand. Wash away any blood from external parts, apply sublimate solution freely to vulva, perineum and tail. Keep the patient quiet for five or six days, and feed lightly on laxative diet. If infection occur mop out the vagina with antiseptics. If abscesses form open them promptly into the vagina or rectum by thrusting an index finger through their walls. If the infection causes difficult defecation by pressure on the rectum or swelling of its coats through inflammatory implication keep the feces pultaceous by means of enemas.

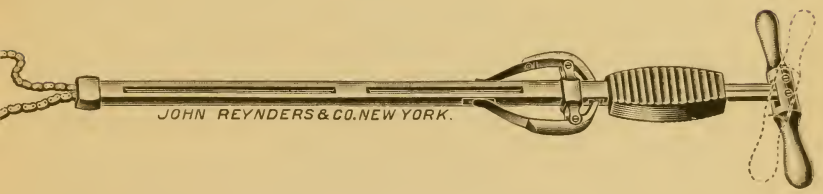

FIG. 25a.—Special spaying ecraseur 55 cm. long.

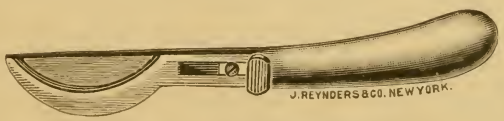

FIG. 25b.—Colin's scalpel.

OPERATIONS ON THE EXTREMITIES.

TENOTOMY OF THE FLEXOR PEDIS TENDON.

Fig. 27.

Instruments. Razor, scissors, sharp tenotome, bandage material.

Technique. Tenotomy is generally performed on the tendon of the deep flexor of the foot or perforans, seldom on the superficial flexor or flexor of the os coronæ of the anterior foot. The horse is laid on that side upon which the affected foot is located and the member to be operated upon is bound upon a narrow board or extension splint of sufficient strength to retain the foot in complete extension. The median side of the foot is upward, the extending splint underneath. [With the operating table the extension splint is uncalled for.] On the median side at the middle of the metacarpus the skin is shaved and disinfected over the tendon of the flexor pedis. The left hand grasps the metacarpus from above and behind in such a manner that the thumb rests upon the median or upper surface of the metacarpus, the index and second fingers on the lateral or under side of the flexor pedis tendon. While the left thumb pushes the skin toward the metacarpal bone, that is, forward, a sharp pointed tenotome held perpendicularly in the right hand is introduced with the cutting edge toward the hoof through the skin, subcutem and antibrachial fascia down to the flexor pedis tendon. Immediately on the anterior border of the tendon insert the tenotome so far that the point of it can be felt on the lateral or outer side through the skin with the left hand. The cutting edge of the knife is then turned against the tendon of the flexor pedis, that is, it is directed backward, the fore foot is extended by an assistant by means of a rope bound around the

pastern and looped around the hoof, and the extensor pedis tendon is cut through under light pressure, by the operator pressing downward on the handle of the knife. A loud

FIG. 27.—Right fore foot of horse bound upon the extension splint. Tenotomy of the flexor pedis tendons. *s*, Tendon of the superficial flexor muscle; *p*, deep flexor tendon.

crackling as well as the disappearance of resistance by extension shows that the tendon is severed. In this way we can avoid injury to the common digital artery, the internal cutaneous vein and the internal and external interosseus

veins which run between the flexor pedis and the suspensory ligament. After the removal of the knife and after seeing that there is a wide space between the ends of the tendons, the foot is unbound from the splint and the bandage applied to the metacarpus, which rests upon the fetlock joint and remains in position for eight days. Healing of the cutaneous wound by primary union.

STRINGHALT OPERATION.

[Tenotomy of the lateral extensor of the pedis.]

Fig. 28.

Instruments. Razor, scissors, sharp tenotome.

Technique. On the lateral side of the metatarsus there is formed a triangle opening toward the tarsus formed by the tendons of the extensor pedis longus muscle and the lateral extensor of the foot which unite on the anterior surface in the middle of the metatarsus. The tendonous sheath of the extensor pedis longus muscle reaches toward the toe to near the point of juncture of the two tendons ; the sheath of the lateral extensor ends below 3 to 4 cm. above the point of union. In the middle of this space without a sheath, which is 3 to 4 cm. long, and below the annular ligament of the hock the operation is carried out, after the skin has been shaved and disinfected. The operation can be performed upon the standing horse, a twitch being applied and the hind foot being taken up as for shoeing. The tendon of the lateral extensor is easily felt under the skin as a hard cord about the size of the little finger. Stretch the skin and grasp the tendon with the thumb and index finger of the left hand, insert the sharp tenotome with the cutting edge toward the foot perpendicularly upon the tendon through the skin, subcutem and aponeurosis derived from the crural fascia ; push the knife from before backward under the tendon, direct the cutting edge of the tenotome against it and with the hock extended sever the

tendon as well as the fascia through to the skin. If the tendon has been completely severed its retracted ends may

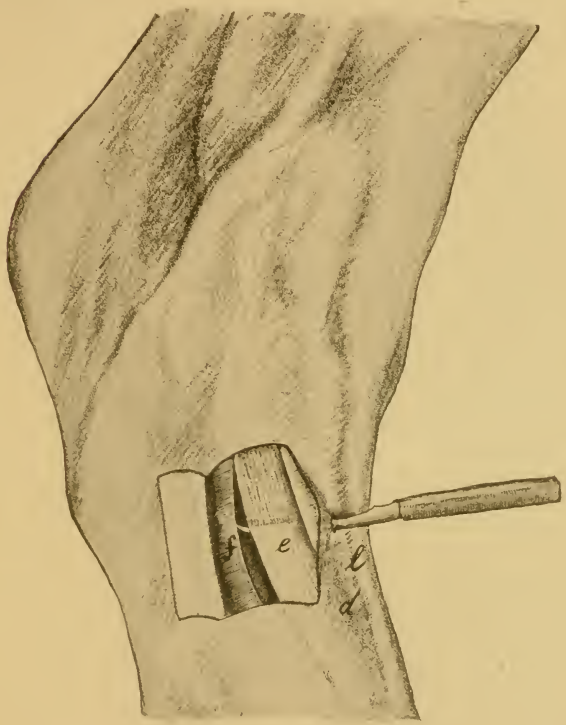

FIG. 28.—Stringhalt operation (tenotomy of the lateral extensor). Right hind foot seen from the external side. The skin covering the lateral extensor of the foot is laid back in the form of a flap, the crural fascia divided. *e*, Tendon of the lateral extensor of the foot (peroneus); *f*, crural fascia; *l*, tendon of the anterior extensor pedis muscle; *d*, the triangle formed by *l* and *e*.

be felt under the skin 1 to 2 cm. above and below the wound. After the operation an antiseptic bandage is applied resting upon the fetlock. The bandage should remain eight days and the cutaneous wound heal by first intention.

CUNEAN TENOTOMY.

Fig. 29.

Instruments. Razor, straight scalpel, tenotome.

FIG. 29.—Cunean tenotomy. Tendon of the cunean branch of flexor metatarsi muscle exposed.

Technique. Most horses can be operated on standing, otherwise cast on the affected side and extend the tarsus. Shave and disinfect an area 5 to 6 cm. square on the inferior median surface of the hock over the course of the cunean tendon of the chief flexor of the metatarsus. Locate the tendon by palpation as it passes obliquely downward and backward and make a perpendicular incision at a point midway between the anterior and posterior borders of the hock or slightly anterior thereto about 1 cm. long, beginning at the lower border of the tendon and extending downwards toward the foot. Insert the tenotome beneath the inferior border of the tendon and depressing the handle cut upwards and outwards through the tendon and fascia to the skin, or inserting the tenotome flatwise between the skin and tendon push it upwards to the superior border of the tendon, then turn the cutting edge of the tenotome toward the tendon and elevating the handle, using the superior border of the wound as a fulcrum, cut the tendon through from above downwards. By firm pressure upon the tenotome in the latter method periosteotomy is simultaneously accomplished. The completion of the operation is evidenced by the retraction of the cut tendon leaving a well marked depression at the point of operation. Disinfect the wound, apply an aseptic bandage and allow to remain undisturbed for 6 days. Healing by primary union.

PLANTAR NEURECTOMY.

Fig. 30.

Instruments. Razor, scissors, convex scalpel, artery forceps, compression forceps, tenacula, needles, suture matereal, elastic ligature.

Technique. A bandage saturated with sublimate or creolin solution is applied to the fetlock joint of the horse 24 hours before the operation, and the animal is cast in such a

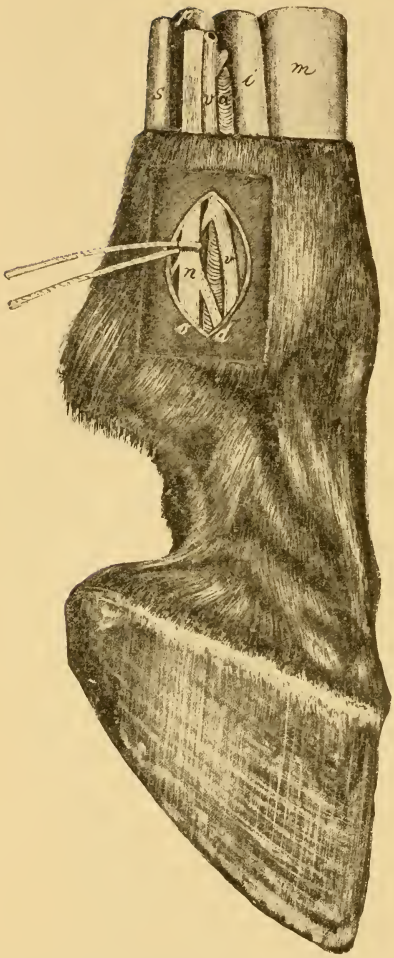

FIG. 30. — Plantar neurectomy. *a*, Lateral digital artery ; *v*, lateral digital vein ; *n*, common lateral digital nerve ; *d*, anterior branch ; *o*, posterior branch ; *s*, superficial flexor tendon ; *p*, perforans tendon ; *i*, suspensory ligament of fetlock ; *m*, metacarpus.

manner that the median side of the foot to be operated upon lies upward ; the nerve on the median side is operated on first [except when both feet are to be operated on at once, when the median plantar on one foot and the external nerve on the other are cut in first position]. Bind the foot upon the extension splint and apply the elastic ligature above the carpus. [With the operating table the extension splint is not required ; the operation is also readily performed on the standing animal with the aid of cocaine.] After removal of the bandage, shave the site of operation and thoroughly disinfect the region of the metacarpus and fetlock with soap, brush, and sublimate or creolin solution and 50 per cent. alcohol. Passing the fingers from before to behind with light pressure over the region of the fetlock joint, there is felt just in front of the flexor

pedis tendon a channel-like depression extending from above the fetlock downward over it. In this channel lies the thread-like cord of the nerve 3 mm. thick, which glides forward underneath the fingers with an audible, palpable recoil. The site of operation lies immediately above the fetlock in the posterior third of the metacarpus. Here stretch the skin between the index finger and thumb of the left hand and make a cutaneous incision between the thumb and finger directly over the nerve 3 to 5 cm. long, the lower angle of which lies immediately above the fetlock joint. The borders of the cutaneous wound are held apart with tenacula and by palpation of the white subcutis with the fingers, it is determined if the nerve lies in the middle of the wound. If this be the case the subcutis is grasped with the forceps and carefully dissected by incisions parallel to the course of the nerve and the blood vessels, until the contour of the nerve is clearly brought out. [We prefer extending the incision directly upon the nerve without any tearing or pulling at the connective tissue by forceps or otherwise]. The nerve is distinguished by its yellowish color, its fine longitudinal fibers and its location behind the blood vessels. Immediately above the fetlock joint the median metacarpal or metatarsal nerve divides into an anterior smaller and posterior larger branch. This division must be laid bare in order that the operator should not erroneously cut one branch only. Immediately above this point of division the aneurism needle armed with the thread is passed under the nerve and the thread tied in a single knot. The pressure of the thread upon the nerve causes severe struggling by the animal. The thread being held taut so that the nerve is drawn above the surrounding tissues insert one blade of the scissors or a small probe pointed bistoury beneath the nerve above the ligature and cut the nerve through quickly at the superior angle of the wound. The nerve is then dissected free as far as possible downward and both branches excised at the lower angle of the wound so that a section 3

to 5 cm. long is removed. In front of the nerve lies the median metacarpal artery and in front of this the median metacarpal vein. The cutaneous wound is united by a continuous suture and a temporary bandage applied. The extension splint is then removed, the foot replaced in the hobble and the horse turned to the other side. Neurectomy of the lateral metacarpal nerve is carried out in the same way after which a sterile bandage is applied which is allowed to remain eight days. Healing by primary union.

DIGITAL NEURECTOMY.

Fig. 31.

Instruments. Razor, scalpel, probe pointed scalpel, tenacula (2), aneurism needles (2), bandages.

Technique. Restraint of animal the same as for the plantar operation. Extending downwards from the fetlock joint toward the coronet, between the posterior border of the phalanges and the deep flexor tendon there is a slight furrow at the posterior part of which, close to the external margin of the tendon, lies the median or principal digital nerve (the chief branch of the metacarpal or metatarsal) accompanied in front by the digital artery, in front of which lies the digital vein. Immediately behind the nerve and generally lying a trifle deeper, is quite commonly found a second venous trunk of considerable size. Near the middle of the first phalanx the nerve is crossed externally in an oblique direction from above to below and from behind to before by a white ligamentous band slightly broader than the nerve extending from the posterior region of the fetlock to the lateral cartilage of the pedal bone. This must not be mistaken for the nerve and need not be if it is remembered that the nerve is accompanied on the same plane and in a like direction by the satellite artery and vein, the former being enclosed with the nerve in a fibrous sheath. Midway between the fetlock and

coronet and over the groove between the flexor pedis tendon and the phalanges shave and disinfect an area 4 to 5 cm.

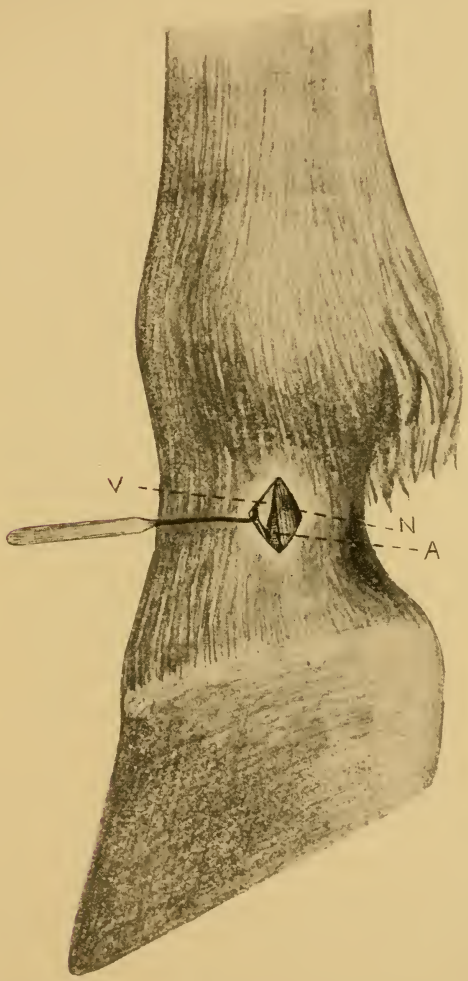

FIG. 31.—Digital (low plantar) neurectomy. *V*, vein; *A*, artery; *N*, nerve.

square. In the center of this area at the anterior border of the flexor tendon, with the scalpel held perpendicular to the skin, make an incision from above downwards a distance of from 2 to 3 cm., cutting cleanly through the skin and subcutaneous fascia down upon the nerve. The incision is favored by tensing the skin between the thumb and index finger of the left hand, but care should be taken to not displace it backwards or forwards. Dilate the wound by pressure with the thumb and index finger or otherwise and carefully incise longitudinally the fibrous sheath enveloping the nerve and artery. Pass an aneurism needle beneath the nerve, and follow with a second aneurism needle immediately beside the first. Draw the two apart, one toward the toe, the other toward the fetlock, and separate thereby the nerve from the surrounding tissues. Remove one aneurism needle, insert the probe pointed scalpel beneath the nerve, and divide it at the upper angle of the wound and excise a section of nerve 3 cm. long. Disinfect and bandage with or without suturing wounds. Leave bandage in place 6 to 8 days.

NRURECTOMY OF THE MEDIAN NERVE.

Fig. 32.

Instruments. Razor, scissors, convex scalpel, artery and compression forceps, tenacula, aneurism needle, suture material.

Technique. The operation is performed on the median surface of the humero-radial articulation on the recumbent horse after the affected foot has been removed from the hobbles and bound upon the extension splint [or fully extended on the operating table]. The foot is drawn out firmly from the shoulder, inclined somewhat forward. The operator kneels between the neck and the forearm and, after the region of the elbow joint is washed with soap and water, searches for the median nerve where it glides over the pos-

terior part of the joint to disappear behind the radius. Shave the skin at this point, disinfect it with soap, sublimate or creolin solution and 50 per cent. alcohol. The nerve lies as a rule somewhat in front of the middle of the median side of the forearm [on a line with the postero-internal margin of the radius] and can be felt lying somewhat deeply about

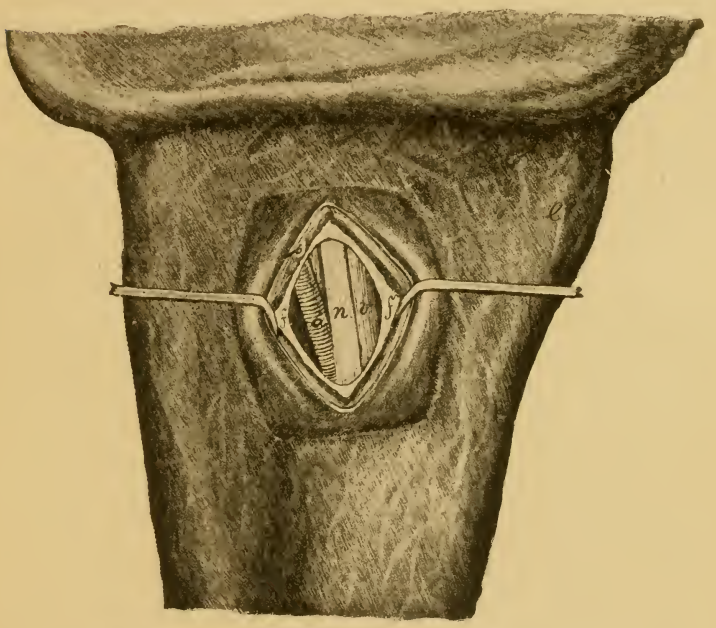

FIG. 32.—Median neurectomy. Median surface of the right humero-radial articulation. *a*, Brachial artery; *n*, median nerve; *v*, brachial vein; *f*, antibrachial fascia; *p*, sterno-aponeuroticus muscle.

5 to 6 mm. in diameter. The position of the nerve varies with the different position of the forearm. In fat and fleshy horses the identification of the nerve is more difficult. The nerve can even be felt upon the standing animal, and determined whether it will be difficult to find or not. With

the nerve lying between the thumb and index finger of the left hand, stretch the superposed skin and immediately upon the nerve and parallel to it make an incision 5 cm. long, first through the skin, then through the sterno-aponeuroticus muscle. Any hemorrhage from the skin, subcutis, or muscle, is checked. The tenacula are inserted in the lips of the wound, and these being drawn apart the white antibrachial fascia is brought to view and a search is made with the index finger to determine if the nerve lies in the middle of the wound, the fascia is divided immediately over the nerve with the scalpel and an oval piece of it excised with the scissors. If much fatty tissue is found between the layers of fascia it may be teased out carefully with two pairs of forceps and cut away with the scissors. There now comes to view a delicate reddish colored fascia-like membrane, the nerve sheath, behind which a blue cord, the brachial vein, is visible, the latter being intimately connected with the nerve sheath. The vein lies mostly behind and beneath the nerve and projects out over the anterior border of the same. [The operator needs be careful not to prick this vein with tenacula, as the hemorrhage therefrom is exceedingly annoying during operation.] Still farther forward may be felt the pulsating brachial artery. Incise the nerve sheath carefully and divide it upward and downward with the scissors, whereupon the yellowish and distinctly fibrous nerve comes into plain view, or carefully part the nerve from the vein with the handle of the scalpel. Carry the aneurism needle beneath the nerve from behind forward and tie the thread around the nerve. The horse usually reacts by powerful struggles. Draw the thread firmly so that the nerve is lifted up and cut it through at the superior angle of the wound by a sudden clip with the scissors [or with the probe pointed scalpel]. After the peripheral end of the nerve has been laid bare to the lower angle of the wound, a distance of at least 3 cm., it is excised. Tamponade the wound with dry iodoform gauze

and approximate the skin with a continuous suture. The tampon and sutures remain from 1 to 2 days. Since the sensation of the lower part of the leg is also maintained by the deep branch of the ulnar nerve which below the carpus, covered by the tendon of the oblique flexor of the carpus, communicates with the lateral plantar nerve, neurectomy of the median nerve does not completely effect the desired end. In order to produce complete anaesthesia, therefore, from median neurectomy, it is necessary at the same time to perform ulnar neurectomy. (Compare following chapter.)

NEURECTOMY OF THE ULNAR NERVE.

Fig. 33.

Instruments. Same as preceding.

Technique. Above and behind the carpus there may be felt a groove between the external and the middle flexors of the carpus. At this point 10 cm. above the pisiform bone the skin is shaved and disinfected and an incision 6 cm long made through the skin and antibrachial fascia. This incision extends just outside the median line of the posterior surface of the radius in such a way that the superior angle of the wound is about 1 cm. farther outward than the lower. Beneath the fascia between the aforementioned muscles is seen the ulnar nerve, on the median or inner side of it the collateral ulnar vein and between the two and somewhat deeper the collateral ulnar artery. The nerve, about 3 mm. in diameter is picked up with the aneurism needle, severed at the upper and lower angles of the wound, the lips of the wound united by a continuous suture and a bandage applied. Healing by first intention. This operation is, as has already been remarked, only carried out in connection with neurectomy of the median nerve.

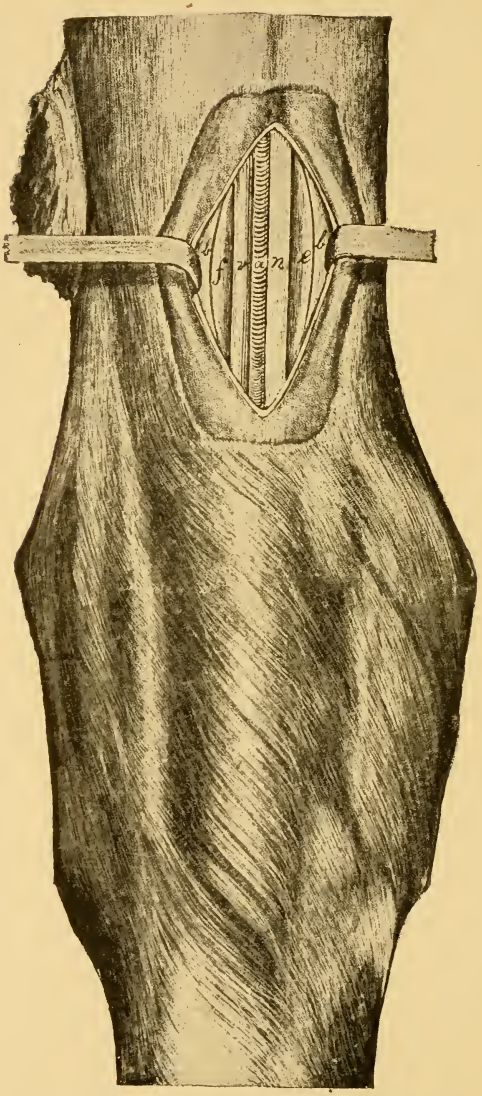

FIG. 33.—Ulnar neurectomy. Right forearm seen from behind. *e*, External flexor of the carpus; *f*, oblique (middle) flexor of the carpus; *a*, collateral ulnar artery; *b*, antibrachial fascia; *n*, ulnar nerve.

BOSSI'S DOUBLE NEURECTOMY FOR SPAVIN.

I. NEURECTOMY OF THE POSTERIOR TIBIAL NERVE.

Fig. 34.

Instruments. As in preceding.

Technique. The operation is performed on the recumbent horse on the inner side of the leg 10 cm. above the summit of the os calcis. The upper foot is bound forward by means

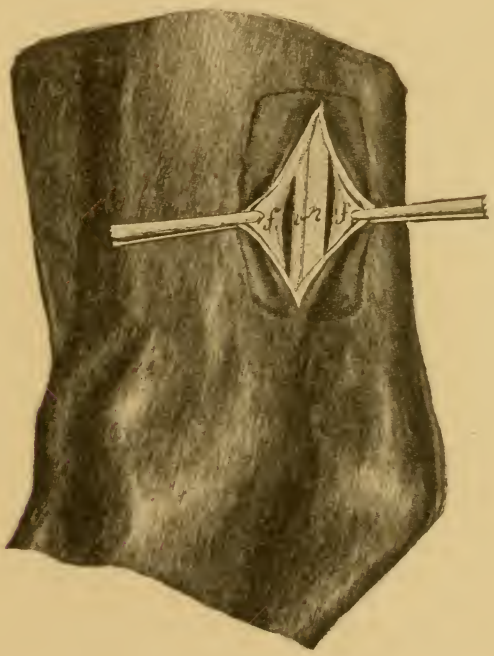

FIG. 34.—Sciatic neurectomy. Right hind leg viewed from the median side. *f*, Crural fascia; *n*, sciatic (tibial) nerve; *v*, plantar vein.

of a side line [or with the operating table the upper foot is secured in the advanced position]. The tibial (sciatic) nerve is then sought for by grasping the leg with the left

hand from behind in such a manner that the thumb rests above and the forefingers below the leg. Reaching forward with the fingers to the deep flexor of the foot grasp the leg with moderate firmness and draw the hand slowly backward. Immediately behind the perforans muscle and between this and the tendo-Achilles the nerve nearly 1 cm. in diameter glides away forward from between the fingers with a palpable and audible recoil. If the nerve can not be found in this manner the hock should be strongly extended, by which means the nerve is caused to recede from the perforans muscle, so that it can readily be felt near the middle of the groove extending between the tendo Achilles and perforans muscle. At this point the skin is shaved, disinfected and an incision made through it 5 cm. long, parallel to the tendo-Achilles. The white rigidly-stretched crural fascia is now divided in the same direction after which it should be determined by palpation that the nerve lies in the middle of the wound, excise with the scissors an elliptic or oval piece of the fascia or hold apart the fascia along with the lips of the cutaneous wound by means of the tenacula. In poor horses the contour of the nerve covered only by loose connective tissue stand out prominently, in fat horses the nerve is surrounded by a large amount of adipose tissue. After this fat and connective tissue has been grasped with forceps it may be excised. The tibial nerve is now in sight, immediately before it lies the plantar vein and on the lateral side (beneath the nerve as the animal lies) is situated the recurrent tibial artery ; separate these completely from the nerve with the handle of the scalpel, pass the aneurism needle from before backward beneath the nerve and cut it off at the upper and lower angles of the wound removing a section of nerve at least 5 cm. long. Suture the cutaneous wound and apply a bandage allowing it to remain eight days. Healing by first intention.

II. ANTERIOR TIBIAL NEURECTOMY.

[Neurectomy of the Deep Branch of the Peroneal Nerve.]

Fig. 35.

Instruments. As in preceding.

Technique. Confine as in preceding with affected leg uppermost. Locate the furrow dividing the extensor pedis longus and lateralis (peroneus) muscles and shave and disinfect the skin over an area 6 cm. long by 3 cm. wide directly over this depression and extending upward from a point 6 or 7 cm. above the tibio-astragaloid articulation.

At a point 8 to 10 cm. above the flexure of the hock make an incision 5 or 6 cm. long over the line of division between the two extensors of the foot, through the skin, the tibial aponeurosis and the special aponeurosis enveloping the extensors. Superficially the operator passes near by the cutaneous division of the anterior tibial nerve. Separating the two muscles for their entire thickness there is found lying deeply 3 to 6 cm. from the surface, and accompanied by a small artery and vein, immediately against the flexor metatarsi magnus, the deep lying branch of the peroneal nerve. Pass the aneurism needle beneath it and remove a piece 3 to 4 cm. long. Close the cutaneous wound with interrupted sutures and dress antiseptically without bandage. This operation is performed only in connection with the preceding and for the same purpose as ulnar, with median neurectomy, *i. e.*, to complete the anaesthesia of the tarso-metatarsal parts.

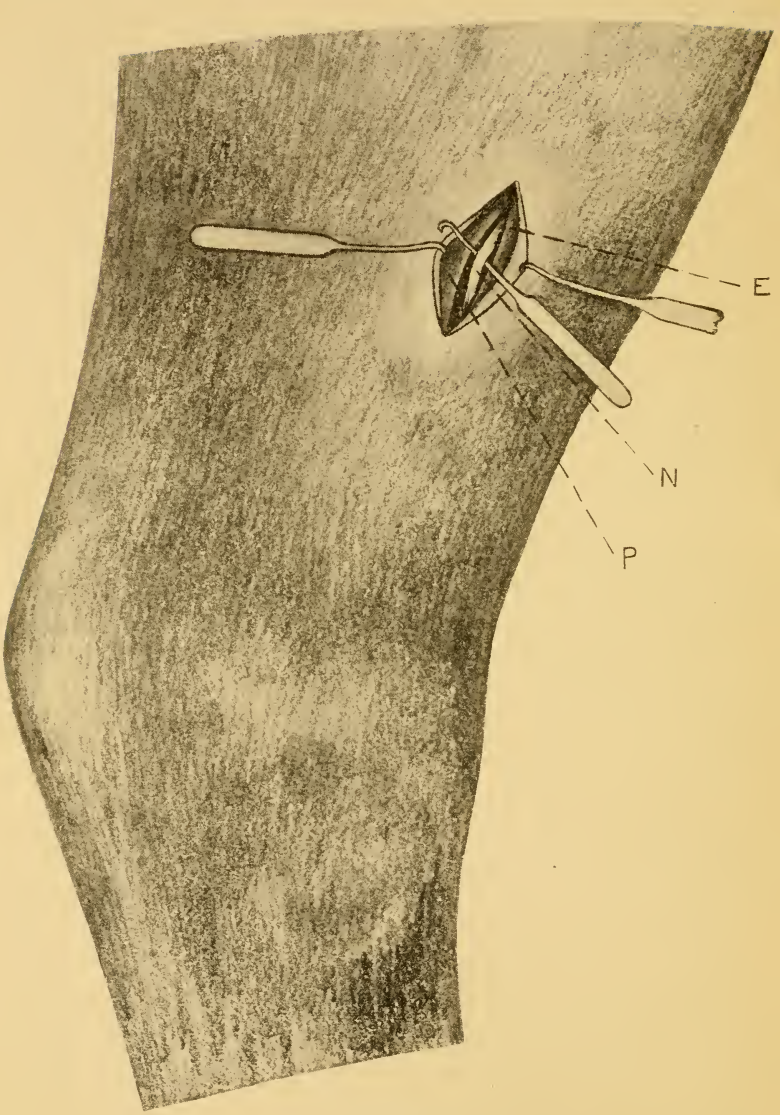

FIG. 35.—Anterior tibial (peroneal) neurectomy. *P*, Peroneus muscle; *E*, extensor pedis longus muscle; *N*, deep branch of the peroneal nerve.

RESECTION OF THE LATERAL CARTILAGE.

(Quittor Operation.)

Fig. 36 and 37.

Instruments. Elastic bandage, drawing knife, scissors, razor, hoof plane, tooth splinter forceps or other heavy forceps for the removal of the horn, artery forceps, double-edged sage knife, curette, needle holder, thread, needles, iodoform ether, iodoform gauze, tampons, absorbent cotton, bandages.

Technique. A few hours before the operation the affected foot of the horse is placed in a bath of creolin solution after having first made a semicircular groove in the horn of the lateral wall and quarter down to the horny lamina. The operation is performed upon the recumbent anaesthetized animal, in such a position that the diseased cartilage of the affected foot lies upwards. After the application of the elastic bandage the groove in the horn is deepened with the drawing knife down to the sensitive laminæ without injuring them. The groove must be so located that it reaches the anterior end of the lateral cartilage, remaining a few cm. distant from the bearing surface of the wall and so that the lower semicircular border approaches the sensitive laminæ abruptly. The hair on the coronary band is clipped or shaved and the entire foot up to the fetlock joint thoroughly cleansed with brush, soap, creolin or sublimate solution and 50 per cent. alcohol. The levator is then inserted beneath the lowest part of the semicircular piece of horn which has been isolated, the horn is elevated from the sensitive structures somewhat, grasped with the splinter forceps and carefully loosened from the sensitive laminæ by drawing upward in the direction of the lamina and by drawing backward from the coronary papillæ and keraphyllous tissue. After the coronary band has been smoothed with the scissors, make two perpendicular incisions through the skin of the coronary band and the coronary band itself, one behind the

anterior and the other in front of the posterior border of the groove in the horn and connect the two by means of a semi-

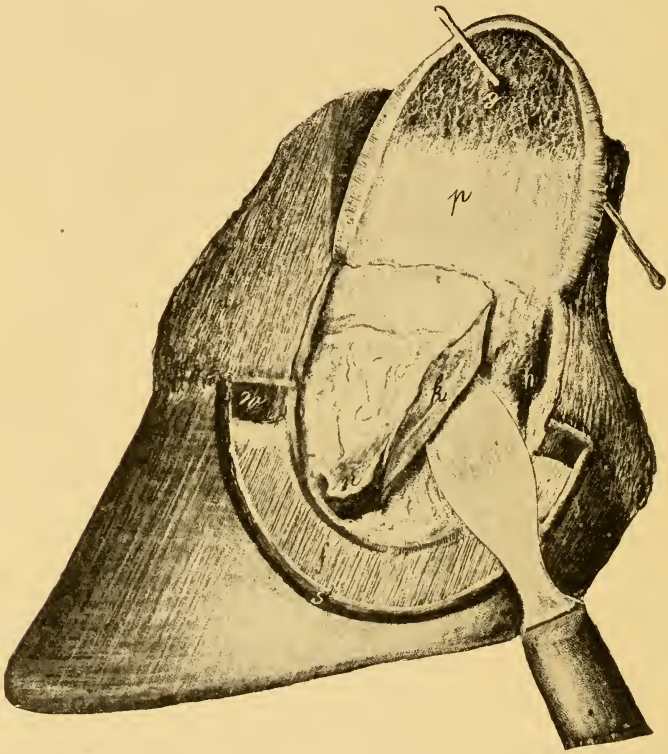

FIG. 36.—Resection of the lateral pedal cartilage. Horny wall removed, sensitive laminæ and cutaneous flap held upwards. Posterior half of the cartilage excised. *f*, Sensitive laminæ ; *w*, coronary band ; *k*, anterior half of cartilage ; *h*, cavity caused by the removal of the posterior half of the cartilage ; *n*, necrotic cartilage ; *p*, parachondral surface of the skin and sensitive laminæ ; *s*, perpendicular, crescent-shaped incision in the horny wall ; *g*, fistula.

circular incision in the sensitive laminæ. This U-shaped incision must be so made that between it and the horny wall

there is left an area of sensitive laminæ at least 2 cm. wide. The isolated flap is now dissected closely against the os pedis and its ala and later from the lateral surface of the cartilage, the operator first lifting the flap with pincers, later with the left hand. Above the cartilage toward the fetlock

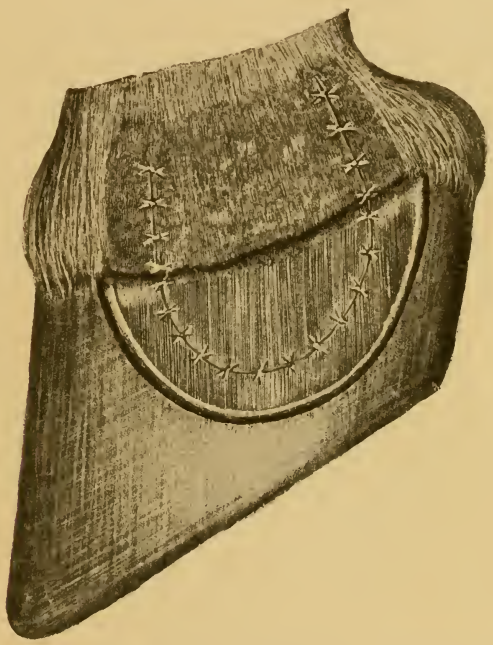

FIG. 37.—Resection of lateral cartilages. Completed operation (sutures).

the operator must keep the fingers of the left hand against the external skin in order to avoid cutting through it or thinning it too much at this point. The flap is held turned upwards by an assistant. As a rule there is now seen a prominent greenish colored necrotic piece of cartilage surrounded by brownish red masses of granulations. By means of an incision through the cartilage parallel to the

axis of the foot, divide the cartilage into anterior and posterior halves and extirpate the latter first, by dissecting it out on the outer and inner side from the parachondral tissue with the double-edged sage knife. The point of the sage knife must be constantly directed against the cartilage. Since the inner surface of the anterior half of the cartilage lies immediately against the capsular ligament of the coronopedal articulation the latter should be sharply extended by which means the capsular ligament is drawn away from the cartilage before its extirpation. The anterior half of the cartilage is then removed in the same way, except with the greatest possible care. Remnants of cartilage and granulations are to be removed with the curette. Then cut away with the scissors and knife any remnants of cartilage adherent to the flap, thin if necessary the entire flap and excise the fistulous openings. After thorough disinfection of the entire field of operation return the flap to its former position and retain it there by a sufficient number of interrupted sutures, irrigate the wound surface with iodoform ether and cover the parts over with iodoform gauze and tampons which rest firmly upon the perpendicular wall of horn. Finally invest the hoof and pastern up to the fetlock joint with oakum and lay a muslin bandage over it, the turns of which must extend from above downward. The bandage is protected by means of a leather shoe or pieces of sacking and the elastic bandage removed. If the animal is free from fever, feels well and eats well, the bandage is left in position from 12 to 14 days. Healing by first intention.

RESECTION OF THE FLEXOR PEDIS TENDON.

Fig. 38.

Instruments. Elastic bandage, drawing knife, double-edged sage knife, scissors, tenaculum forceps, curette, bandage material.

Technique. Before the operation the horn of the sole, the frog and the bars are thinned down until the soft parts can be seen through them and an antiseptic bandage applied saturated with creolin solution. Cast the horse [or confine on operating table] chloroform and bind the foot to be oper-

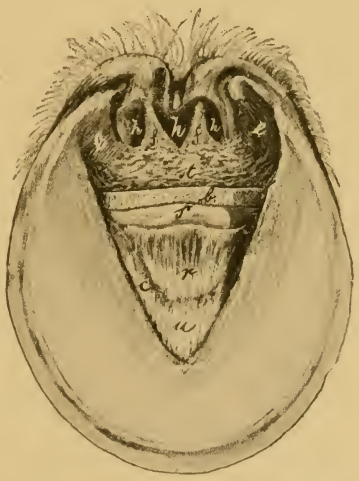

Fig. 38.—Resection of the flexor pedis tendon. Solar surface of the foot. *c*, Semilunar crest of os pedis; *u*, os pedis; *r*, navicular-pedal ligament; *s*, navicular bone; *b*, flexor pedis tendon; *e*, sensitive laminæ of the bars; *st*, fatty frog; *f*, sensitive frog; *h*, horny frog.

ated upon to the foot diagonal to it, [or on the operating table secure it firmly] apply the elastic bandage to the foot and carefully disinfect the hoof with soap, brush, creolin or sublimate solution and 50 per cent. alcohol. Then make

a transverse incision through the base of the frog 2 to 3 cm. from the balls through the horny frog, the sensitive frog, and the fatty cushion down to the flexor pedis tendon. Follow this by two curved incisions extending forward and inward in an oblique direction corresponding to the semilunar crest of the os pedis, the line of incision being about ½ cm. outward from the lateral groove of the frog and uniting at the apex of the frog. This triangular piece of frog which has been isolated by the incision is now grasped with the pincers and dissected away. As a general rule the operator finds that he has not yet reached the flexor pedis tendon but only the fatty cushion which covers the latter. The remnants of the fatty frog should be removed with the double-edged sage knife by means of a horizontal incision, and there is then seen the greenish or yellowish colored necrotic flexor pedis tendon which may at times be covered with reddish colored granulations. Should the operation be indicated on account of a suppurative pododermatitis the bars on the affected side must be excised along with the other portions. The position and extent of the navicular bone can be determined by feeling through the flexor tendon. A transverse incision is then made over the middle of the navicular bone through the flexor pedis tendon to the bone, the lower end of the tendon is grasped with the tenaculum forceps and lifted up from the navicular bone with the aid of two lateral curved incisions. Between the inferior border of the navicular bone and the semilunar crest of the os pedis stretches the capsular ligament of the inferior articulation of the navicular bone and os pedis reinforced by dense fibrous bands. The flexor pedis tendon is united to this by a few bundles of fibres. Dissect the tendon carefully away from the capsular ligament and beyond from the semilunar crest of the os pedis. If necrotic or discolored pieces of the fatty cushion or the tendon still remain, remove these with scissors, scalpel or curette. With the latter curette the roughened cartilage of the navicular bone and

remove necrotic portions of bone. In extensive necrosis of the suspensory ligaments of the heel and of the ligaments extending from the fetlock joints to the lateral cartilage the necrotic ligament as well as the neighboring fatty cushion with its numerous elastic fibers, must be resected. Disinfect the operation wound, irrigate with iodoform ether and tamponade it with dry iodoform gauze. Over this apply a firm pad of oakum, enclose the entire hoof up to the fetlock in oakum and apply over this a bandage. Over the bandage apply a leather shoe or heavy canvas and remove the elastic bandage. In the absence of fever the bandage remains in position for eight days.

AMPUTATION OF THE CLAWS IN CATTLE.

Figs. 39 and 40.

Instruments. Half round rasp, double edged sage knife, scissors, convex scalpel, artery forceps, drawing knife, elastic bandage.

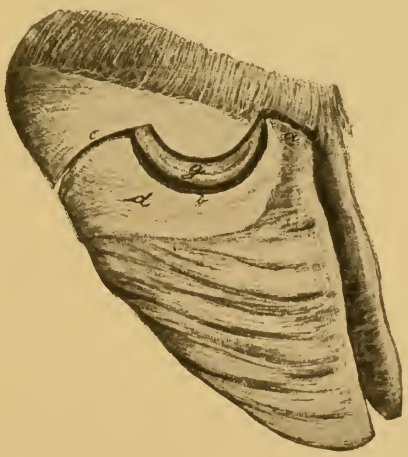

FIG. 39.—Amputation of the claws of cattle. *d*, Horny wall, rasped thin ; *g*, articular condyle of 2nd phalanx ; *a*, *b*, *c*, course of incision.

Technique. Cast the animal and secure the foot to be operated upon in an extended position, apply the elastic bandage after disinfecting the claws with soap and brush and creolin solution, rasp away the horn on the lateral side of the diseased claw, especially at the posterior part of it,

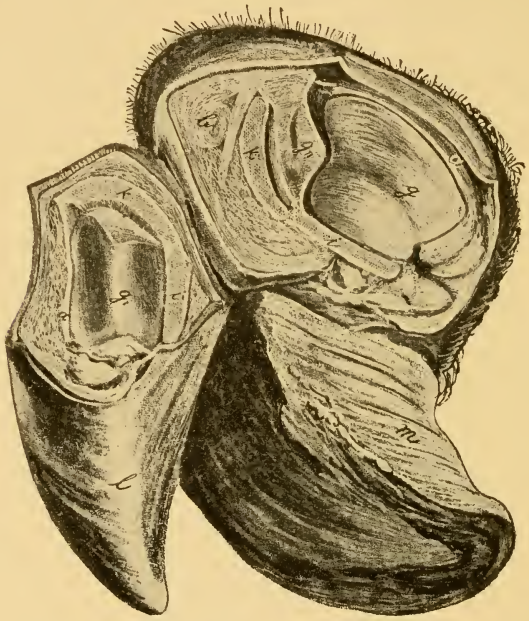

FIG. 40.—Amputation of the lateral claw of cattle. Median claw preserved. Viewed from the solar surface outward. *a*, External corono-pedal ligament; *i*, internal do; *k*, tendon of the flexor pedis muscle; *g*, distal articular surface of the 2nd digit; *g'*, articular surface of 3rd digit; *g''*, navicular bone; *l*, lateral claw; *m*, median claw; *b*, bulb of the heel.

until the horny wall becomes so thin that it can be readily pressed in with the fingers. The corono pedal articulation can be felt, about 3 cm. below the coronary band, by grasping the claw with the left hand in such a manner that

the thumb rests upon the thinly rasped horn while with the other hand the claw is moved from side to side. At the lowest point of the articulation push the double-edged sage knife into the joint, the cavity of the knife being directed toward the fetlock, and make in the joint a curved incision at first forward and upward to the neighborhood of the coronary band then with strong flexion of the foot a second curved incision backward and upward which, however, extends only to the navicular bone. By this incision the operator divides the horn, the sensitive lamina, the external corono-pedal ligament and the capsular ligament of the corono-pedal articulation. Pass the knife between the navicular and pedal bones and extend the incision downwards perpendicular to the solar surface to the sole, separating the navicular bone from the os pedis. In this manner the navicular bone is preserved as well as the ball of the heel, the latter of which is of special significance in healing. The inner wall of the claw with the powerfully developed corono-pedal ligament is divided from before backward. After the vessels which can be seen are ligated the articular surfaces of the navicular and coronary bones curetted and the necrotic remnants of tendon removed an antiseptic bandage, preferably of tar, is applied and a leather shoe or canvas covering placed over it for protection. The bandage remains for 12 or 14 days.

APPENDIX.

THE BAYER SUTURE.

Fig. 41 and 42.

Instruments. 1. Large curved suture needle armed with a strong silk thread, about 20 cm. long, which is doubled and passed through the eye in such a manner that the closed end extends considerably beyond the open ends.

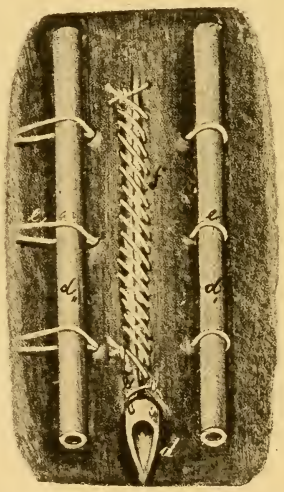

Fig. 41.—Retention, and continuous approximation sutures. $d, d'\ d''$, Drainage tubes ; e, retention suture (closed end) ; e', open end ; b, fixation suture for the drainage tube ; f, continuous approximation suture.

2. Small needles and thread. 3. Needle forceps. 4. Drainage tubing preferably two very large and one small with lateral openings. 5. Thin wooden splints 15 cm. long,

3 to 4 cm. wide, with rounded ends. 6. Iodoform gauze. 7. Iodoform ether 1 : 10.

Technique. After the skin has been shaved over an area having a radius of 5 to 6 cm. from the wound, the suture needle is inserted 2 to 3 cm. from the lips of the wound through the skin and subjacent tissues, a strong drainage tube (*d'*) passed through the closed end of the suture and the thread drawn tight. The needle is then passed through

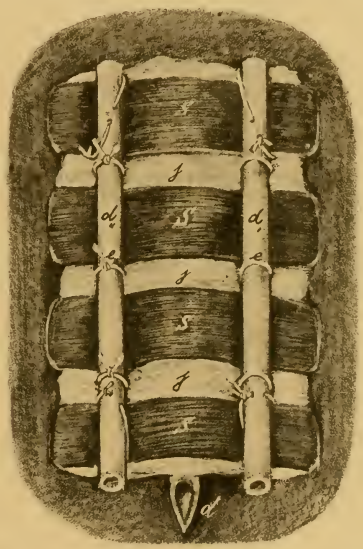

FIG. 42.—Splint bandage. *d*, *d'*, *d''*, Drainage tubes; *e*, retention suture (closed end); *e'*, do, open end; *j*, iodoform gauze; *s*, splints.

the opposite lip of the wound from within to without at the same distance from the lips of the wound, the second large drainage tube (*d''*) is laid between the open ends of the double silk thread and these are tied upon the drainage tube with a triple knot, after they have been drawn sufficiently tight that the approximated wound lips form a

crest. If the lips of the wound can be grasped with the hand and held together in such a manner as to form a ridge 3 or 4 cm. high, the suture needle can be passed through both lips of the wound simultaneously. The first suture should be located about 3 cm. beneath the upper angle of the wound, the other retention sutures follow at distances of about 5 cm. from each other and are applied in the same way. The lips of the wound are united by continuous approximation sutures like an overcasted seam. This suture ends at least 2 cm. above the lower angle of the wound. The third drainage tube is introduced into the latter and fixed by a special suture. The entire cutaneous surface lying between the drainage tubes is covered with iodoform gauze, and between each two retention sutures there is laid over this gauze the wooden splints previously cut to the proper size, the ends of which are shoved under the tubing. The upper and lowermost splints must be bound to the drainage tubing by means of sutures passed through the tubing. The entire bandage is finally saturated with iodoform ether. The bandage and retention sutures remain eight days, the approximation sutures fourteen days.

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